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Collective Reputation in Trade: Evidence from the Chinese Dairy Industry

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Abstract

The existence of collective reputation implies an important externality. In the context of international trade, quality shocks affecting one firm could affect the demand of other firms in the same origin country. We study such reputation spillovers in the context of a large-scale scandal that affected the Chinese dairy industry in 2008. Leveraging administrative data at the firm-product level and official quality inspection reports, we find that after the scandal, the export revenue of firms with contaminated products dropped by 84% relative to the national industry trend. We estimate the spillover effect on firms without contaminated products to be 64% of the direct effect, with firms that successfully passed government inspections suffering as much as uninspected firms. We further investigate the potential mechanisms underlying these reputation spillover effects. We find that the spillover effects are smaller for destinations where people have better information about the parties involved in the scandal. The spillover effects appear to be generalized, rather than contained to the specific areas with suppliers of contaminated products, consistent with global buyers having coarse information about the sources of contamination. Finally, new exporters and firms with less export experience are more vulnerable to collective reputation damage than established exporters. **(JEL: F10, F14, L15, L66, O10, O19)**

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1 Introduction

In markets with information frictions, quality shocks about one firm's products may impose an externality on other firms selling similar products. In such settings, when an incident damages the group's reputation, firms can become trapped in a low-trust-low-quality equilibrium, and new entrants may inherit the damaged reputation of their predecessors. Tirole (1996) formalizes the theory of collective reputation. Empirically, how important is collective reputation, and what are the potential mechanisms that mediate its effects?

We study collective reputation in the context of trade and development. In international markets, producers from the same origin country are often viewed as a group: for example, we refer to Swiss watches, French wines, and "made-in-China" products. For firms in developing countries, which are mostly positioned at the lower end of the value-added chain and export mainly non-branded products, a long international supply chain can make it particularly difficult to trace products to an individual producer. As a result, collective reputation becomes especially important in determining firms' export performance. In fact, rising safety and quality concerns regarding goods from developing countries in recent years can significantly hinder firms from penetrating high-end markets.[2] In a recent survey of over 600 manufacturing firms in China, firms report lack of reputation and mistrust as one of the main challenges in exporting to global markets.[3] Therefore, understanding how collective reputation spreads within an industry or a geographic area is important for informing trade and development policies.

We exploit a large-scale quality scandal that affected the Chinese dairy industry in 2008. Similar to many industries in developing countries and emerging markets, the Chinese dairy

[2]A list of food contamination incidents can be found at https://en.wikipedia.org/wiki/List_of_food_contamination_incidents#2001_to_present. Recent prominent cases include the Chinese dairy scandal of 2008 and the Brazilian meat scandal of June 2017 (see an *Economist* article on the latter incident: https://www.economist.com/news/business/21719416-chile-china-and-eu-have-banned-some-or-all-countrys-meat-meat-scandal-brazil).

[3]The survey was administered by the Jinan Institute for Economic and Social Research (IESR) and the Guangzhou General Administration of Quality Supervision, Inspection and Quarantine (GAQSIQ). We thank IESR for sharing the survey instruments and the data.

industry was dominated by a large number of small and non-established players that exhibited rapid growth prior to the scandal. Using administrative data on quality inspections conducted by the Chinese government following the scandal, we identify the firms and the products at each firm that failed inspections (contaminated product-firm pairs) and those products and firms for which no contamination was ever detected.[4] We merge the official inspection lists with Chinese Customs data at the firm-product level and Manufacturing Survey data at the firm level to examine the direct effects of the scandal both on contaminated product-firm pairs and on other products within the firms with contamination (within-firm spillovers) as well as the effects on firms with no contamination and on uninspected firms (cross-firm spillovers).

We begin by showing that the scandal had a large impact on the overall export performance of the entire dairy sector in China, thus providing an ideal setting for studying within-sector spillovers. Using a difference-in-differences (DD) framework, we find that the average value of dairy exports plummeted by 68% following the scandal and failed to recover even after five years. This estimate captures both the direct impact on firms with contaminated products and the spillovers to other firms and products. Decomposing the direct versus indirect impacts, we estimate an aggregate spillover effect of 57%, about four-fifths of the total effect size. Our estimates are robust to various empirical specifications that relax the classical DD assumption. To the extent that products by different dairy firms are imperfect substitutes, the estimates provide a lower bound on the collective reputation effect.

Next, we investigate how the spillover effects are distributed across different firms and products. We leverage our detailed micro data on export activities and inspection outcomes at the firm-product level. Our results suggest that contaminated firms saw a drop of 84% in export revenue after the scandal relative to the national industrial trend. These firms were also 14.2% less likely to export following the scandal. Furthermore, we find that both firms

[4]We conducted an extensive news search through LexisNexis to cross-validate the official inspection reports. See Section 3.3 for more details.

verified to be free of contamination and uninspected firms experienced an equally significant decline in export revenue of about 64% of the decline suffered by directly affected firms. Moreover, firms that successfully passed government inspections did not fare any better than uninspected firms. Altogether, these findings point to large reputation spillovers and highlight the potential challenges of government actions to help firms signal quality and restore trust.

Finally, we investigate potential mechanisms that may underlie the observed spillover effects. Since a firm's reputation is essentially constituted by buyers' beliefs and perceptions, how consumers gather information and learn matters crucially for reputation externalities. Specifically, we examine the role of 1) information accuracy in global media reports, 2) firms' location and the traceability of suppliers affected by contamination episodes, and 3) firms' export experience, which proxies for the strength of individual reputation.

First, to study the role of information accuracy in global media, we construct a measure of consumers' knowledge of the scandal across different countries, using Google Trends Search indices for phrases that reflect a more or less accurate depiction of the event. We find that the spillover effects are smaller in countries where people appear to have better information about the parties directly involved in the scandal, reflected in more targeted internet search behavior. In particular, the cross-firm spillover effects are primarily driven by exports to destinations with low information accuracy.

Second, we use the Chinese Customs data to identify the sourcing locations of each exporting firm prior to the scandal to examine the impact on firms that passed inspections and uninspected firms of sourcing from the same locations as firms affected by the contamination. Interestingly, we find that the spillover effects appear to be generalized rather than contained within specific areas. This is consistent with international buyers having coarse information about contamination sources due to low traceability of the contaminated inputs.

Third, to examine the interaction between collective and individual reputation, we exploit baseline variation in firms' export experience, as measured by the number of years a firm has

been exporting and the share of exports in total sales at baseline. We find that young firms and firms with a smaller baseline share of exports in total sales are more vulnerable to the collective reputation shock. The results suggest that having a more established individual reputation can (partially) shield firms from the collective damage, whereas newcomers suffer more from the "original sin" of the predecessors (Tirole, 1996).

A growing empirical literature studies firm reputation and quality provision in markets with information frictions (Banerjee and Duflo, 2000; Jin and Leslie, 2009; Macchiavello, 2010; Cabral and Hortacsu, 2010; Björkman-Nyqvist, Svensson, and Yanagizawa-Drott, 2013; Bardhan, Mookherjee, and Tsumagari, 2013). While information frictions appear to play an important role in international trade (Allen, 2014; Macchiavello and Morjaria, 2015; Startz, 2017), these frictions remain understudied (Atkin and Khandelwal, Forthcoming). We build upon these two bodies of research by examining the role of group reputation in trade. Our results demonstrate that collective reputation forces can have important implications for a country's trade patterns, contributing to a country's comparative advantage.

Despite earlier works on the theory of collective reputation (Tirole, 1996; Winfree and McCluskey, 2005; Fleckinger, 2007; Levin, 2009; Fishman, Simhon, Finkelshtain, and Yacouel, 2010), empirical studies on the subject remain scarce (Bai, 2018; Zhao, 2018). Exploiting a natural experiment, our results explicitly identify this important source of externalities and illustrate how its effects are mediated by various informational and market forces. Two other papers exploit similar natural experiments to study collective reputation spillovers. Freedman, Kearney, and Lederman (2012) examine toy recalls in the US and document sizable industry-wide spillover effects independent of origin country.[5] Bachmann, Ehrlich, Fan, and Ruzic (2019) find large spillover effects a year after the Volkswagen scandal on US sales

[5]Our paper also speaks broadly to the literature on quality scandals and product recalls. Most previous studies in this literature have either relied on laboratory experiments to examine consumer reactions to hypothetical product scandals (e.g., Ahluwalia, Burnkrant, and Unnava (2000)) or focused primarily on stock market outcomes using an event-study approach (e.g., (Davidson and Worrell, 1992)). Furthermore, with the exception of Freedman, Kearney, and Lederman (2012), most studies focus on losses in firms' own sales and stock market price (Van Heerde, Helsen, and Dekimpe, 2007; Jovanovic et al., 2020) rather than cross-firm spillovers.

of other German cars. To the best of our knowledge, our study is the first one with a long enough post period to examine the persistence of collective reputation damage. More work is needed to compare developing and developed countries as well as different market settings.[6]

Finally, our study relates to the broad literature on firm performance and quality upgrading in development and trade (De Loecker and Goldberg, 2014). Previous studies have examined (1) supply-side constraints, including credit access, lack of quality inputs, and managerial constraints (e.g., De Mel, McKenzie, and Woodruff (2008); Kugler and Verhoogen (2012); Banerjee (2013); Bloom, Eifert, Mahajan, McKenzie, and Roberts (2013)), and (2) demand side factors, including access to high-income markets (e.g., Verhoogen (2008); Park, Yang, Shi, and Jiang (2010); Manova and Zhang (2012); Atkin, Khandelwal, and Osman (2017)). Atkin and Khandelwal (Forthcoming) highlight that information frictions may significantly inhibit trading opportunities for firms in developing countries. Our paper is one of the first to document how a poor collective reputation deriving from information frictions affects firms' export performance in developing countries.

The remainder of the paper is organized as follows. Section 2 provides background information on the 2008 scandal, and Section 3 describes the data. Section 4 presents evidence on the overall impact of the scandal on the dairy industry. Section 5 analyzes reputation spillovers across firms and products. Section 6 examines mechanisms. Section 7 concludes.

2 Background on the 2008 Chinese Dairy Scandal

The Chinese dairy industry exhibited fast growth during the early 2000s in terms of both domestic production and exports. Prior to 2008, the industry grew at an average annual

[6]There is also a literature in agricultural and resource economics that studies collective reputation in the food and beverage industries in relation to products and labels such as Bordeaux wine and regional appellations. Most studies use hedonic price regressions to examine the role of group reputation (e.g., Castriota and Delmastro (2014); Marchini, Riganelli, Diotallevi, and Paffarini (2014); Gergaud, Livat, Rickard, and Warzynski (2017)). We take advantage of a natural experiment that allows us to relax the identification assumptions.

rate of almost 24%. Figure 1 shows that the industry's annual export value increased more than threefold from 2000 to 2007. The number of exporting firms increased from 150 in 2000 to 335 in 2007.[7] Nonetheless, in 2007, dairy exports still constituted a relatively small share of all dairy production in China and accounted for only $300 million of the country's $1.2 trillion export revenue. Like many other industries in developing countries, the Chinese dairy industry was dominated by a large number of small and non-established players.

Over the past decade, an increasing number of quality and safety issues have affected Chinese food products. One of the most widely known incidents is the distribution of contaminated baby formula in September 2008, hereinafter referred to as "the scandal". Infant formula had been illegally adulterated with the industrial chemical melamine to mimic a higher protein content. Melamine, commonly used in the manufacture of plastics, has been linked to an increased risk of kidney stones (Hau, Kwan, and Li, 2009). The incident led to 4 infant deaths, 51,900 hospitalizations of children and the nationwide recall of 700 tons of milk powder.

Following the outbreak, the Chinese government quickly shut down the supplier of the contaminated milk powder, Sanlu Group, one of the largest dairy firms in China. However, further investigations revealed that the adulteration stemmed from malpractices of some upstream milk producers, raising the suspicion that more downstream dairy firms could have been affected.[8] This discovery led to three rounds of government inspections: the first round targeted firms producing infant formula—109 firms were inspected, and 22 were found to have traces of melamine in their products. The next two rounds targeted producers of milk powder and liquid milk, respectively, and covered most dairy producers in China. During the second round, the government inspected 154 randomly sampled milk powder producers

[7] Figure 1 shows a spike in export growth between 2006 and 2007, when the total value of exports increased by about 138%. This spike was mainly driven by new firms entering the export market. Specifically, 30 firms contributed more than 80% of the growth spike; over 50% of the spike was driven by a single product—milk powder; finally, over 50% of the spike was driven by exports to 6 destinations, namely, Thailand, Germany, Bangladesh, Taiwan, UAE and Hong Kong.

[8] According to the investigation reports, these malpractices were "open secrets" in the industry. See https://www.wsj.com/articles/SB122567367498791713.

(together making up over 70% of the market share) out of 290 producers nationwide and found 20 to be contaminated. During the third round, the government targeted another 466 established dairy brands with large market shares and found that 9 plants of 3 major brands were contaminated. That said, large firms appear to have been disproportionately targeted in the second inspection round as well: in Section 3.4, we find that inspected firms are significantly larger in terms of baseline sales and employment. Our identification strategy accounts for this imbalance by including a rich set of baseline controls interacted with time to allow for differential growth trajectories between large and small firms.[9]

These inspections uncovered contamination in several dairy and dairy-related products, including yogurt, milk, cheese, baby food, and cake. Product recalls were immediately issued. By the end of 2008, the Chinese government had issued an official statement that the incident had been fully addressed and that proper measures had been put in place to ensure the safety of the dairy products on the market.[10] Corroborating the Chinese government's statement, data from the EU's Rapid Alert System for Food and Feed (RASFF), which publishes safety notifications and recalls for imported food products, show that notifications related to melamine contamination in dairy products imported from China surged in the fall of 2008 but quickly subsided a few months after the initial outbreak (Figure A.1).

Despite the official statement, the scandal triggered widespread fears over food safety in China. Thousands of Chinese dairy-related products were pulled from supermarket shelves across the world. Some countries stepped up inspections for Chinese imports, while others issued explicit import bans for products containing dairy ingredients from China. For instance, EU authorities imposed tests on Chinese imports containing more than 15% of milk powder and announced a ban on all Chinese products containing milk for children; the

[9] In addition to the three big rounds of inspections targeting downstream dairy firms, the Chinese government conducted checks at upstream facilities and shut down a number of milk stations. We do not have systematic data on these upstream inspections, partly because many of the suppliers were very small and informal.

[10] http://www.telegraph.co.uk/news/worldnews/3079146/China-claims-tainted-milk-scandal-is-over.html

US Food and Drug Administration restricted imports of all Chinese food products containing milk; India imposed an import ban on milk and all milk-related products from China that was extended until 2019. Our news search identified 43 destinations (out of 157) that imposed explicit regulatory bans on certain Chinese dairy imports (Table B.1).

The scandal had a long-lasting impact on the dairy industry in China. The GAQSIQ stopped issuing national exemption status to domestic food producers[11] and tightened inspections on domestically produced food products. Dairy firms also tightened their standards for purchased raw milk, and some started their own upstream milk farms to better control quality. However, Figure 1 shows that despite these actions, dairy exports sharply declined after 2008 and had not recovered by the end of 2013, the end of our sample period. At the same time, dairy imports in China rose rapidly after the scandal (Figure A.2), suggesting that domestic consumers also switched to foreign dairy products in response to safety concerns about domestic producers.

3 Data

We merge three micro-level data sets: the Chinese Customs Database, the Chinese Manufacturing Survey, and the list of inspections conducted by the Chinese government.

3.1 Chinese Customs Database (2000-2013)

The Chinese Customs Database provides information on trade flows for the universe of China's exports and imports. We focus on exports for this study. We observe the exporting firm's name, location, export value, and export quantity, the HS eight-digit product code, the city in China from which the product is sourced, and the final export destination. We compute unit prices for exported products by dividing the value of export by the quantity.

[11] This policy was previously known as the "inspection-free" program, which gave exemption status to qualified food producers and waived various quality inspections for these firms.

For our industry-level analysis in Section 4, we aggregate the data to the HS two-digit industry-year level; for our spillover analysis in Sections 5 and 6, we aggregate the data to the firm-product-year level.[12] Figure A.3 shows that China's overall exports grew rapidly in the early 2000s following China's entry into the World Trade Organization (WTO).

We define the dairy industry using the HS eight-digit product classification. Most dairy products fall under the HS two-digit code 04, while infant dairy products fall under 19 and milk protein products extracted from raw milk fall under 35. Table B.2 provides the full list of the HS eight-digit codes and descriptions for dairy products.

3.2 Chinese Manufacturing Survey (2005-2009, 2011-2013)

The Chinese Manufacturing Survey data are compiled from annual surveys conducted by the National Bureau of Statistics (NBS) and include all state-owned and non-state-owned industrial firms with sales revenue above 5 million RMB. Even though a large number of small to medium-size industrial firms (80%) are excluded from the sample, they account for only a small fraction of the total economic and export activities in China. In particular, the excluded firms employ 28.8% of the industrial workforce but produce only 9.3% of the total output and generate 2.5% of the export revenue (Brandt, Van Biesebroeck, and Zhang, 2012). Our spillover analysis in Sections 5.2 and 6.3 focuses on dairy firms within the manufacturing sector. For each firm-year, we observe production and financial information, including firms' four-digit industry code, years of operation, total sales, employment, and export revenue. When export revenue is missing, we complement the observation using the Customs data: we follow the standard procedure for matching firms across the Manufacturing Survey and the Customs data using name and address information.[13]

[12]For observations from years prior to 2006, the data include exact the export date. For years after 2007, only monthly data are available. We collapse the data to the year level to account for monthly seasonality in exports.

[13]This matching is not 100% accurate, as documented in the literature (e.g., Kee and Tang (2016)). Of the 335 dairy firms appearing in the Customs data in 2007, we can identify 151 in the Manufacturing Survey. The lack of matches for the remaining 184 firms could be due to mismatches in firm names or the fact that

3.3 Government Inspection Lists

Section 2 describes the three rounds of inspections implemented by the Chinese government after the scandal. For each round, the government released the list of products inspected at each firm and the inspection results. We obtained the inspection lists (at the firm-product level) from the GAQSIQ website. To cross-validate the information in the official reports, we conducted an extensive news search through LexisNexis: all the media-reported cases of contamination that we found appeared in the official inspection lists.

We merge the firm-product-level inspection lists with the Customs data using firm names and product information and with the Manufacturing Survey data using firm names (since the latter data do not include product information). We classify merged firms into one of three categories: contaminated, innocent, and uninspected. Contaminated firms have at least one product found to be contaminated during one or more rounds of inspections. Innocent firms passed the tests for all of their inspected products. Uninspected firms were never inspected. We analogously classify products into the following categories: contaminated products are those found to be contaminated in at least one of the inspected firms, and innocent products are those that cleared inspection in all firms inspected.

3.4 Summary Statistics

Our spillover analysis in Section 5 uses two samples. First, we use our linked Customs-Inspections sample to study the scandal's spillover effects on the export performance of dairy firms at the firm-product level. This sample includes 1,868 firm-products across 1,464 firms and 25 products. Of these, we identify 149 contaminated firm-product pairs in 67 contaminated firms and 413 innocent firm-product pairs in 95 innocent firms. Second, we use our linked Manufacturing Survey-Inspections sample to study the scandal's spillover effects on the domestic performance of the dairy firms. This sample includes 1,687 firms, 73

the Manufacturing Survey includes only above-scale firms.

of which were contaminated and 352 innocent. Restricting the sample to firms that appear in the Manufacturing Survey both before and after the scandal reduces the sample to 238 firms: 19 contaminated and 103 innocent.

Table 1 presents firm-level baseline (2000-2007) summary statistics for export performance measures in the linked Customs-Inspections sample (Panel A) and for employment and total sales in the Manufacturing Survey-Inspections sample (Panel B). It compares contaminated (Columns 1-2), innocent (Columns 3-4), and uninspected firms (Columns 5-6). Column 7 calculates the difference in means between contaminated and uninspected firms (Columns 2 and 6), and Column 8 reports the p-value of this difference. On average, contaminated firms have larger export revenue and are more experienced than innocent firms; however, they are not systematically different from uninspected firms (Panel A). Contaminated firms are larger in terms of both employment and sales revenue than both innocent firms and uninspected firms (Panel B). This pattern is consistent with the Chinese government targeting larger firms in the third round of inspection.[14] Even for the second round of inspections, which were claimed to be random, inspected firms appear to differ from uninspected firms on several observable characteristics, including the value of exports in 2007 (Table A.2). Section 5 discusses how our empirical framework addresses selection into inspection.

Table 2 presents product-level baseline summary statistics for the same export performance measures in the Customs-Inspections sample for dairy (Panel A) and non-dairy (Panel B) products. On average, contaminated products are exported in larger quantities and for longer export periods than innocent and uninspected products. Contaminated products also appear to be less likely to be exported to countries in the Organisation for Economic Cooperation and Development (OECD) although the difference is not significant.

Figure A.4 plots the number of export products and destinations for contaminated, innocent, and uninspected firms before and after the scandal. Many firms exported a single

[14]Table A.1 shows similar patterns for firms producing non-dairy food products.

product to a single destination. In Section 5, we discuss how these patterns generate the variation that we exploit for the firm-product-level analysis.

4 Impact of the Scandal: Industry-Level Analysis

This section estimates the overall impact of the scandal on the export performance of the Chinese dairy sector. Section 4.1 discusses our preferred empirical specification, a difference-in-differences (DD) specification, as well as threats to the validity of the DD assumptions and additional tests we perform that relax these assumptions. Section 4.2 presents our DD estimates. Our finding that the scandal decreased the total value of dairy exports by 68% over the course of five years motivates us to further explore within-sector spillovers across firms and products in Section 5.

4.1 Empirical Specification

Equation (1) presents our baseline DD specification, which compares the value of exports of the dairy industry (the treated industry) to the value of exports of other two-digit-level industries before and after 2008, the year of the scandal.

$$Y_{jt} = \beta_{\text{dairy}} \text{Dairy}_j \times \text{Post}_t + \gamma_j + \delta_t + \pi X_{jt} + \epsilon_{jt} \tag{1}$$

Y_{jt} is the natural logarithm of the value of exports for industry j in year t; Dairy_j is an indicator for the dairy industry; and X_{jt} includes time-varying controls at the industry level, such as the value share exported to different continents at baseline (2000-2007) interacted with year indicators. These covariates control for differential trends in destination countries that may affect different industries differently. In our preferred specification, we include 79 non-food control industries. Non-dairy food exports may also be affected by the scandal if foreign consumers update their perceptions about the quality of Chinese food products in general. We cluster standard errors at the industry level, allowing for arbitrary correlation

in error terms across time for a given industry.

The internal validity of the DD design rests on the assumption that the treated and control industries would be on parallel trends absent the scandal. This parallel trends assumption may not hold in our context for two reasons. First, as discussed in Section 2, prior to the scandal, dairy exports grew rapidly, a growth episode that might not be paralleled in other industries. Second, the global financial crisis in 2008 could have affected different industries differently. If so, we may erroneously attribute to the scandal an export decline in dairy products that was in fact due to the crisis. While perfectly overcoming these concerns is challenging in the current context, we perform a series of robustness checks, detailed in Appendix C. Our estimates of the impact of the scandal are robust to several specifications that relax the parallel trends assumption, such as including a vector of industry-specific linear time trends. Moreover, an interactive fixed effect model (Gobillon and Magnac, 2016) and a synthetic control model produce qualitatively and quantitatively similar estimates to those produced by the DD design, despite relying on different identification assumptions.

4.2 Results: Difference-in-Differences

Table 3 presents estimates of Equation (1). We focus first on Panel A. The baseline specification in Column 1 includes only year and industry fixed effects and estimates a decline of 65.5% in the value of dairy exports following the scandal.[15] Columns 3 and 4 build on this specification by adding time-varying controls and industry-specific linear trends. Our preferred specification in Column 4 estimates that the value of dairy exports plummeted by 68% following the scandal. Column 2 expands our sample to include non-dairy food industries. The coefficient on the interaction between the food-industry indicator and the post-scandal indicator suggests that the scandal did not affect the non-dairy food industry in an economically and statistically significant way.

[15]Because most of the coefficients that we estimate are large in magnitude, we compute elasticities using the following formula: Elasticity $= (e^{\text{Coeff}} - 1) \times 100$, where Coeff is the estimated coefficient reported in the tables.

Panel A estimates the overall impact of the scandal on the dairy industry, capturing both the direct impact on contaminated firm-products and the spillovers to innocent and uninspected firms and products. Panel B disentangles the aggregate spillover effect by excluding contaminated firm-products from the treated (dairy) industry. We estimate a 57% decrease in exports for innocent and uninspected firm-products, about four-fifths of the total effect of the scandal.[16] The difference between the spillover and the total effect is only statistically significant in our preferred specification in Column 4.

5 Reputation Spillover: Firm-Product-Level Analysis

Motivated by the findings in the previous section, we examine how the impact of the scandal spilled over across firms and products within the dairy sector. We study both the direct impact on contaminated firm-products and the spillover effects *within* and *across* firms in the industry. To do so, we use our Customs-Inspection sample described in Section 3 to exploit *within-industry* variation in involvement in the scandal. Our main regression specification is as follows:

$$\begin{aligned} Y_{fpt} &= \beta_{\text{direct}} \text{CFirm-Product}_{fp} \times \text{Post}_t \\ &+ \beta_{\text{within-firm}} \text{CFirm}_f \times \text{Post}_t \\ &+ \beta_{\text{across-firm}} \text{CProduct}_p \times \text{Post}_t \\ &+ \lambda_1 \text{IFirm-Product}_{fp} \times \text{Post}_t \\ &+ \lambda_2 \text{IFirm}_f \times \text{Post}_t \\ &+ \gamma_{fp} + \delta_t + \epsilon_{fpt} \end{aligned} \tag{2}$$

We restrict the analysis to the dairy industry. The dependent variable Y_{fpt} is an outcome

[16] An analogous analysis shows that dairy imports significantly increased relative to imports in other sectors after 2008 (Table A.3) as domestic consumers switched to foreign brands following the crisis.

for firm f's product p in year t, including the inverse hyperbolic sine (IHS) transformation of export revenue and export quantity, the natural logarithm of export price, and an indicator for exporting.[17] Except for the price outcome, we first create a balanced panel at the firm-product and year levels to capture extensive-margin responses (i.e., entry and exit into export). CFirm-Product$_{fp}$ is an indicator for contaminated firm-product pairs directly involved in the scandal: the indicator equals 1 if a given product of a firm was inspected and failed the quality test. CFirm$_f$ is an indicator for contaminated firms: the indicator equals 1 if a firm was inspected and *at least one* of its products failed the test. CProduct$_p$ is an indicator for contaminated products: the indicator equals 1 if at least one of the inspected firms failed the quality test for the given product. IFirm-Product$_{fp}$ and IFirm$_f$ are defined similarly: IFirm-Product$_{fp}$ is an indicator for innocent firm-product pairs that were inspected and passed the quality test. IFirm$_f$ is an indicator for innocent firms that passed the quality test for *all* of their inspected products.

Identification relies on the assumption that unobserved firm-product-year-specific shocks that affect the outcomes are uncorrelated with the initial inspection status. In other words, absent the scandal, all firm-products would have seen the same growth in export performance over time. However, the Chinese government did not choose which firms to inspect randomly. As discussed in Section 3.4, inspected firms are on average larger than uninspected firms.

To assuage concerns of omitted variable or selection bias, our preferred specification includes 1) firm-product (γ_{fp}) and 2) year (δ_t) fixed effects as well as 3) an interaction of baseline firm-product export volume with the post-scandal indicator. First, this specification partials out time-invariant firm-product unobservable characteristics, such as quality. Second, it controls for common nationwide dairy industry time trends, such as global demand shocks. Third, differential trends for firms of different sizes account for potentially different growth trajectories during the dairy boom prior to the scandal. Thus, our analysis

[17] We use the IHS transformation for export revenues and quantity to obviate the fact that we have missing firm-product-year cells when exports are zero (Burbidge, Magee, and Robb, 1988).

captures differential changes in performance across firm-products over time. To examine the sensitivity of our results, we also estimate an alternative specification including firm, product and year fixed effects separately (Table A.4). We cluster standard errors two ways at the product-year and firm level, allowing for arbitrary correlation in error terms over time for a given firm and across firms for a given product-year. This two-way clustering allows for persistent shocks within a firm over time as well as for cross-sectional yearly shocks affecting all firms producing the same products.

The omitted category in Equation 2 includes innocent products and uninspected products from uninspected firms. Therefore, $\beta_{\text{across-firm}}$ identifies the impact of the scandal on uninspected firms selling one of the products found to be contaminated in other firms (i.e., *cross-firm* spillovers). $\beta_{\text{within-firm}}$ identifies the overall impact on the contaminated firms (i.e., *within-firm* spillovers), whereas β_{direct} captures the additional impact on their directly involved products. Similarly, λ_1 and λ_2 capture the impact on innocent firms and innocent firm-products relative to the omitted group. Given that the regression is done at the firm-product-year level, Table A.5 presents an overview of the variation in the data by counting the number of observations falling under different cells, namely, contaminated versus non-contaminated firms and products before and after the scandal.

We present our baseline estimation results in Section 5.1 and discuss their interpretation in Section 5.2 as well as alternative explanations and robustness checks in Section 5.3.

5.1 Results: Direct and Spillover Effects on Exports

Table 4 reports the main estimates from Equation (2). Column 1 examines the impact of the scandal on the IHS of export revenue and shows large within-firm and cross-firm spillovers. Specifically, we estimate $\hat{\beta}_{\text{within-firm}} = -1.8$, which is significant at the 1% level; that is, contaminated firms experienced a drop of 84.1% in export revenue after the scandal relative to the national trend and the firms' average performance. Within contaminated firms, directly involved products were affected more–the estimated coefficient β_{direct} is meaningful (-0.489,

or -38.7%) but imprecisely estimated, suggesting that there may be heterogeneous impacts among directly contaminated firm-products. Another possibility is that since most products within the contaminated firms were affected, the coefficient is only picking up any *differential* impact of contaminated versus innocent and uninspected products within those firms.

In line with the industry-level analysis in Section 4, we also see a large negative spillover effect on firms selling contaminated products: the estimate for $\beta_{\text{across-firm}}$ is -0.773 (or -53.8%) and is significant at the 1% level. Finally, the effects on innocent firms and products are mixed: while the coefficient on IFirm-Product×Post is large and positive, the overall impact on innocent firms, relative to uninspected firms, is negative. Neither of these estimates is statistically significant.

Column 2 examines the effects of the scandal on the IHS of export quantity and finds similar results. Comparing the estimates of $\beta_{\text{across-firm}}$ in Columns 1 and 2, the decrease in quantity explains 97.9% of the cross-firm spillovers, after entry and exit are taken into account.

Column 3 examines changes in unit price on the unbalanced panel of firm-product-year observations with positive export activity. The estimate of $\beta_{\text{across-firm}}$ is -0.157 (-14.5%) and is significant at the 10% level. The direct impact on contaminated firm-products is -0.122 (-11.5%) but is not statistically significant, whereas the within-firm spillover $\hat{\beta}_{\text{within-firm}}$ is positive at 0.209 (18.9%) with a standard error of 0.051. One possible explanation for this positive within-firm price coefficient is that contaminated firms disproportionately raised the prices of their non-contaminated products to make up for lost revenue. Alternatively, contaminated firms may have incurred larger cost shocks (for example, costs of recalling products or clearing government inspections) than non-contaminated firms and partially passed those costs through to final consumers. The estimated $\beta_{\text{within-firm}}$ captures the net of these additional spillover effects in addition to potential reputation spillovers.

Column 4 examines the impact of the scandal on the extensive margin and finds that contaminated firms are 14.2% less likely to export after the scandal. The estimate for $\beta_{\text{within-firm}}$

is significant at the 1% level, whereas the one for β_{direct} is indistinguishable from 0. All Chinese dairy firms carrying products found to have been contaminated during the scandal, regardless of whether the firms themselves are innocent, contaminated or not inspected, are 6.2% less likely to export those products, and the estimate of $\beta_{\text{across-firm}}$ is significant at the 1% level. The results on innocent firms and products are again inconclusive.

We examine how persistent the direct and spillover effects are by fully interacting the firm-product group dummies in Equation (2) with year dummies. Figure 2 plots the regression coefficients with 95% confidence intervals for two outcome variables: log value of exports and exporting indicator. Both the within-firm and cross-firm spillover effects persist more than five years after the scandal and display little sign of recovery.

Our findings contrast with estimates of reputation spillover effects in developed countries. For example, Freedman, Kearney, and Lederman (2012) and Bachmann, Ehrlich, Fan, and Ruzic (2019) document cross-firm reputation spillover effects for US and German manufacturers, respectively, that are much smaller than what we estimate for Chinese dairy firms. This difference in magnitude suggests that information frictions may be larger in developing countries.[18] Mistrust of government agencies in developing countries may make it more difficult for firms to recover from damages to collective reputation. More work is needed to draw systematic comparisons across different countries and market environments.

5.2 Interpretation: The Role of Government Inspections

We find large cross-firm spillovers in export performance, including for uninspected firms. However, we find mixed evidence of reputation spillovers to innocent firms and products. These findings highlight the potential challenges of government inspection efforts in helping firms signal quality. First, the public may perceive government inspections to be a negative

[18]Specifically, Bachmann, Ehrlich, Fan, and Ruzic (2019) finds that other German auto manufacturers experienced a 9.2 percentage point reduction in sales growth rate from 2015 to 2016 following the VW scandal. Freedman, Kearney, and Lederman (2012) finds that sales revenue during the Christmas holiday season declined by 30% for unaffected toy manufacturers in the US after a related scandal.

signal. Being inspected may have been taken to indicate that something was not right ("bad signaling effect"), even though some inspections were allegedly targeted at random. Second, being mentioned in news reports on the scandal may impose a stigma if customers do not pay attention to the details of the news. Ma, Wang, and Khanna (2016) discuss this "reminder (salience) effect".

Both the bad signaling and reminder effects may also be present in the domestic market, potentially making government inspections ineffective. Figure A.2 and Table A.3 show that the scandal increased imports, suggesting mistrust of domestic brands. To shed light on domestic spillover effects, we turn to the Manufacturing Survey data, which are only available at the firm level. We restrict the analysis to a balanced sample of firms to account for survey composition changes.[19] In total, 238 dairy firms appeared in all years between 2005-2009 and 2011-2013, out of 1,687 that ever appeared during this period. These firms account for 49.8% of the total dairy production during this period.

Table 5 estimates the impact of the scandal on this sample of continuing firms. We cluster standard errors at the firm level, as product-level information is not available in this sample. The coefficients are not precisely estimated. Qualitatively, we see a negative impact of the scandal on contaminated firms, while innocent firms do not appear to perform better than uninspected ones. These findings are consistent with the bad signaling and reminder effects acting on the domestic market and highlight the challenges that governments may face in restoring trust. These results speak to the importance of understanding how consumers acquire information. We come back to this point in Section 6 when we discuss the mechanisms underlying the reputation spillover.

[19]Section 3.2 explains that the Manufacturing Survey only includes firms with sales revenue exceeding 5 million RMB. Thus, we cannot distinguish between true exits due to the scandal versus mere reductions in scale.

5.3 Alternative Explanations and Robustness Checks

This section considers several alternative explanations aside from reputation spillovers that may contribute to the results in Section 5.1 and presents additional robustness checks.

5.3.1 Differential Time Trends

Different subindustries within the dairy sector may have followed different growth trajectories in the absence of the scandal, leading to biased estimates of the spillover effects. Table A.4 allows for differential time trends across subindustries at the HS two-digit level. Reassuringly, these results are qualitatively very similar to the results in Table 4.

Reversion to the mean could also bias our results. If contaminated firms were growing faster prior to the scandal, our estimates may be partly driven by these fast-growing firms mechanically scaling down their production and reducing exports after the scandal. To alleviate this concern, we allow for differential time trends with respect to baseline sales in our baseline specification. In Table A.6, we further exclude firms and destination countries that account for most of the export growth spike between 2006 and 2008 (see the discussion in Section 2). The results are very similar.[20]

5.3.2 Confounding Supply-Side Factors

Collective reputation represents a demand-side force, but supply-side forces may also have contributed to the observed spillover effects. For example, the scandal disrupted the activities of some upstream suppliers: some milk farmers and milk stations exited the market as a result. Similarly, stronger government regulations may have imposed additional costs on firms, raising their production costs. All these supply-side forces could have led to reductions in export revenue and quantity. However, a pure upward shift of the supply curve would have resulted in an unambiguous increase in price (conditional on exporting), contrary to

[20] As discussed in Section 2, a few predominant firms and export destinations drove the growth spike in the pre-scandal period (2006-2007).

what we estimate in Table 4, Column 3: the coefficient on CProductXPost, the key collective reputation spillover effect, is negative and significant at the 10% level.[21] This result alone implies that the demand curve must have moved downward and offset the supply curve movement. While we cannot completely rule out supply-side movements, we conclude that the demand-side force due to collective reputation effects played an important role in this context.

5.3.3 Confounding Foreign Demand Shocks

Different firms may be subject to idiosyncratic demand shocks depending on the conditions in the destination countries that they export to. If contaminated firms were more likely to export to countries that happened to demand more or fewer imported dairy products after 2008, the estimated coefficients would be biased. To examine this possibility, we construct a measure of firm-specific demand shocks using a firm's baseline export value share for each destination country multiplied by each destination country's yearly dairy imports from the rest of the world excluding China and summed over all destinations. Table A.4 shows that our results are robust to including these firm-specific demand shocks as additional controls.

5.3.4 Foreign Import Regulations Due to Protectionist Motives

Import regulations targeted at all firms from the same origin-industry can result in patterns similar to those estimated in Table 4. Table B.1 lists the 20 countries plus the EU that imposed explicit import bans on Chinese dairy products after the 2008 scandal by the countries' value share in total dairy exports from China.

One way to think about such trade policies is that foreign governments react on behalf of domestic consumers in light of rising safety concerns about products imported from a particular country. Such blanket regulations represent an underlying channel for the collective

[21] We can estimate the price regression on a balanced sample of exporters (i.e., firms that exported both before and after the scandal) to account for any sample composition change; the results are robust.

reputation effect. Alternatively, these regulations may arise from protectionist motives. In other words, foreign countries could take advantage of the scandal to raise import barriers. Empirically distinguishing these two stories is challenging. Table A.7 presents estimates only for the sample of destinations without explicit import bans. These results are very similar to our main estimates, suggesting that explicit government regulations cannot fully explain the spillover effects. Market-based forces due to collective reputation do matter.

6 Mechanisms

In this section, we investigate three potential mechanisms that may mediate the strength of the reputation spillover effects documented in Sections 4 and 5. Since a firm's reputation consists essentially of buyers' beliefs, how consumers gather information and learn matters crucially for reputation externalities. Thus, the mechanisms that we investigate relate to what may shape consumers' information sets. Specifically, we examine the roles of 1) information accuracy in global media reports, 2) firms' location and the traceability of contaminated suppliers, and 3) firms' export experience. All of these forces can act jointly and interact with one another. Rather than trying to disentangle and quantify the impact of each, our goal is to examine whether a particular force has bite.

6.1 Information Accuracy in Global Media Reports

A large literature has shown that the media influence people's perceptions, thereby affecting a wide range of social and economic outcomes (DellaVigna and Gentzkow, 2010). In the context of food scares, Adda (2007) and Luong, Shi, and Wang (2019) show that news information alters consumers' perceived risk of encountering low-quality products and thereby affects demand. Therefore, how the media report an event shapes the event's impacts. We investigate an important aspect of media reports on the scandal: informational accuracy, that is, the level of detail with which media outlets described the involvement of different

firms in the scandal. Figure A.5 shows a typical Chinese media report on the scandal (left panel), which includes a full list of contaminated firms and products, and an example from the Western media, the *New York Times* (right panel), which only reported an estimated number of contaminated firms without mentioning any specific names.

Such heterogeneity in media reports across countries can generate different information sets among local consumers. We can imagine two scenarios: one in which consumers perfectly understand the evolution of the scandal and are able to closely keep track of the inspection outcomes and another in which consumers have trouble identifying the contaminated firms and worry about Chinese dairy products in general as a result of the scandal. Collective reputation forces would be stronger in the latter scenario than in the former.

To construct a systematic measure of consumers' information accuracy across different export destinations, we leverage Google Trends data. Google Trends provides public time series indices based on Google Search data, which capture how often a search term is entered relative to the total search volume in a given geographical area. To allow comparisons of relative popularity across search terms, each data point in Google Trends indices is divided by the total searches in the corresponding geographical area and time range and scaled on a range of 0 to 100 for any given period. We collect data for 31 countries available on Google Trends and construct the relative search intensity ratio for two keywords—"Sanlu" versus "2008 Chinese milk scandal"—for each country. Figure 3 displays the relative search intensity across countries. Web users in Japan, China, Hong Kong, and New Zealand, for example, searched for "Sanlu" much more than the generic phrase, suggesting that consumers in these locations may have been more informed about the parties directly involved in the scandal. In comparison, the searched information appears to have been much less specific in countries such as Myanmar, Pakistan, Austria, and Vietnam.[22] We classify countries into two groups based on the relative search intensity: high indicates a higher ratio (top quartile) and thus

[22]Figure A.6 shows the search behavior across provinces in China. Not surprisingly, Hebei province, where the headquarters of Sanlu was located, has the highest search intensity for the keyword "Sanlu".

higher information accuracy (Figure 3).[23]

Table 6 reports the effect of the scandal on export performance to destinations with high and low search intensity ratios. Consistent with consumers in countries with low information accuracy not being able to distinguish innocent and contaminated firms, the cross-firm spillover effect ($\hat{\beta}_{\text{across-firm}}$) is driven by exports to destinations with low information accuracy (-0.639 compared to -0.025, with a p-value for testing equality of 0.0016). In Table A.8, we further divide countries into quartiles of the information accuracy measure. We find suggestive evidence of bigger cross-firm spillover effects as information worsens.

Overall, these results show that information accuracy plays an important role in mediating the force of collective reputation. Information accuracy may be particularly relevant in the context of international trade, as media coverage of events that happen in foreign countries, where information needs to travel far, may be less precise.

6.2 Firms' Sourcing Location

Next, we investigate how firms' location mediates the strength of reputation spillovers. In the case of the Chinese dairy scandal, contamination stemmed from wrongdoings in the upstream sector, as discussed in Section 2. Given that dairy firms from the same location tend to source inputs from the same local upstream farms, one may expect to see stronger spillover effects on innocent and uninspected firms located in the same areas as contaminated firms.[24] To examine this aspect, we take advantage of the Chinese Customs data, in which

[23]This measure of information accuracy may be correlated with countries' baseline market share of Chinese dairy exports, potentially confounding the estimation results. Regressing the Google search index on countries' baseline market share yields a low R-square of 0.007 (0.005), suggesting that most variation in information accuracy cannot be explained by market share. One factor affecting information accuracy could be how the scandal was covered in the local media, which may depend on political attitudes.

[24]In general, the source of contamination and the public's knowledge of this information matter for the degree of reputation spillovers. If the root cause of a quality defect is limited to a well-known individual firm, consumers may not be concerned about other firms in the same origin-industry. One example of a defect that involved a single firm only is the case of the Samsung Galaxy battery fire, the aftermath of which did not affect any other South Korean phone brands. By contrast, if the quality defect stems from upstream production processes, as was the case in the Chinese dairy scandal, all downstream firms may suffer from reputation spillover effects, especially if inputs are hard to trace. A scandal about the product quality of one

firms are required to report the sourcing location for each of their export transactions. We leverage this information to identify whether a city hosts any contaminated firms for a given product; if so, we call it a "contaminated city". We define an indicator variable CSourceCity for firm i that equals 1 if i sourced (any product) from a contaminated city prior to the scandal. We define another indicator variable CSourceCity-Product that equals to 1 if i ever sourced contaminated product j from the same city as a contaminated firm. We interact these indicator variables with the post-Scandal indicator to study how baseline sourcing patterns affected firms' post-scandal export performance.

Table 7 reports the impact of sourcing from a contaminated location for innocent and uninspected firms. While we estimate large overall cross-firm spillovers (the negative coefficient on CProductXPost), the exact sourcing location of a firm does not appear to matter: the point estimates on the two additional interaction terms are very close to zero, though the standard errors are fairly large. The result suggests that the spillover effects were generalized rather than contained around contaminated sources. One potential explanation is that international buyers may have very coarse information about contamination sources due to the low traceability of the contaminated inputs; as a result, the spillover effects are not localized. This echoes our previous findings that information accuracy matters for the strength of reputation spillover effects. Moreover, to the extent that firms in one location compete for the same labor and upstream supplier inputs, innocent and uninspected firms may have benefited when their rivals were hit by the scandal. The estimated coefficients thus reflect the net of the reputation and competition effects.

6.3 Firms' Export Experience

A firm's reputation can have both an individual component and a collective component: for example, consumers may observe a quality signal from each firm as well as a noisy signal

firm may cause consumers to worry about the quality of other firms that source from the same upstream sources.

of the industry's average quality. In this case, a strong individual reputation may mitigate the impact of a collective reputation shock. To examine this possibility, we proxy a firm's individual reputation in the global market by its export experience, measured by the number of years the firm had been exporting prior to the scandal and the firm's baseline share of exports in total sales.

Table 8 shows the heterogeneous impact of the scandal based on export experience. Due to our short baseline period, we define new (young) firms as those that had just started exporting in 2008 and established firms as those that had exported for one or more years prior to 2008. Consistent with individual reputation shielding a firm from collective reputation shocks, the cross-firm spillover effect is larger for new exporters. Here, too, we allow for differential time trends with respect to firm size, which is likely to differ between new and established exporters. A test of equality of $\hat{\beta}_{\text{across-firm}}$ in Columns 1-2 (or Columns 3-4) has a p-value of 0.0191 (or 0.0734). The test of equality of the spillover effects on the extensive margin, $\hat{\beta}_{\text{across-firm}}$ in Columns 5-6 (or Columns 7-8), has a p-value of 0.0335 (or 0.1313). These findings suggest that in light of a collective reputation shock, a more established individual reputation can (partially) shield firms from the collective damage, whereas newcomers are more likely to suffer from the "original sin" of their predecessors.

Table A.9 explores an alternative measure of export experience based on firms' fraction of exports in total sales in 2007. For this exercise, we merge the Chinese Customs data with the Manufacturing Survey data and use the total sales information in the latter. Of the 335 dairy firms in the Chinese Customs sample in 2007, 151 are identified in the Manufacturing Survey. The relatively low match rate could be due to the imperfect matching of firms' names and addresses across the Manufacturing Survey and the Chinese Customs data or the fact that the Manufacturing Survey only includes above-scale firms (see Section 3.2). Figure A.7 plots the distribution of the fraction of exports in total sales in the baseline year. On average, conditional on exporting, exports account for 10.3% of the firms' total sales (the median is 9.8%) with a standard deviation of 0.35. We classify firms as large exporters if

their fraction of exports exceeds the median and small otherwise. The results again suggest that small firms tend to suffer more from collective reputation damage.

Summary: This section explores three mechanisms potentially driving collective reputation spillover effects. First, information accuracy plays an important role in mediating the strength of collective reputation—the spillover effects are smaller in destinations where people appear to have had better information about the parties involved in the scandal. Second, the spillover effects appear to be generalized rather than localized to contaminated sources, consistent with international buyers having coarse information about contamination sources due to low traceability of the contaminated inputs. Finally, individual reputation can mitigate collective reputation damage, and new exporters and firms with larger baseline export shares appear to be the most vulnerable to collective reputation shocks.

7 Conclusion

Understanding how reputation spreads within an industry or a geographic area is key for informing trade and development policy, as the existence of collective reputation implies important externalities. We study this question in the context of Chinese dairy firms' exports following the 2008 scandal. We document strong reputation spillover effects on firms whose products were not contaminated. Surprisingly, firms that cleared formal inspections do not appear to have fared any better than uninspected firms. These findings highlight the role of collective reputation in international trade and the challenges that governments may face in signaling quality and restoring trust. Analyses of potential mechanisms highlight the role of information accuracy, supply chain traceability and firms' individual reputations in mediating the collective reputation effect.

Our study has two broad policy implications concerning 1) the role of government and third-party certifications and 2) the role of market structure. That said, the external validity of the results is an empirical question, as the exact magnitudes of spillovers vary across

industries and countries and depend on whether directly affected firms are large industry leaders or small players. Our approach can be applied to other contexts.

First, collective reputation may call for government interventions, but government-led inspection efforts may generate counterproductive signals, depending on the reputation of the inspection body itself. Private third parties and international certification bodies may act as an effective complement to or substitute for government regulations, especially in developing-country settings. However, based on our interviews with firms in the Chinese dairy industry, third-party certification has not been adopted in this sector. This could be due either to high costs or logistical hurdles in obtaining these certifications or to perceived low returns to certification. Understanding the barriers to adoption as well as the effectiveness of these programs is crucial for designing policies that could assure a high quality standard and break the low-quality-low-reputation equilibrium.

Second, this study takes a first step in investigating various mechanisms that may affect the transmission of reputation spillovers. Understanding these mechanisms can help inform policies in response to a collective reputation crisis. Following the milk scandal, many firms integrated vertically with upstream farms. One rationale for vertical integration is the ability to enforce stronger quality controls (Hansman, Hjort, León, and Teachout, 2017); an equally important rationale is to signal quality, so that a firm is better shielded from wrongdoing by other firms' suppliers. It is expected that by 2020, over 70% of Chinese raw milk will be produced from vertically integrated milk farms.[25] Future work is needed to better understand how collective reputation affects firms' quality investment incentives. Acting as an important externality, collective reputation could also have rich interactions with other market forces, such as market entry and competition.

[25]News source accessed on 09/28/2020: http://www.gov.cn/zhengce/content/2018-06/11/content_5297839.htm.

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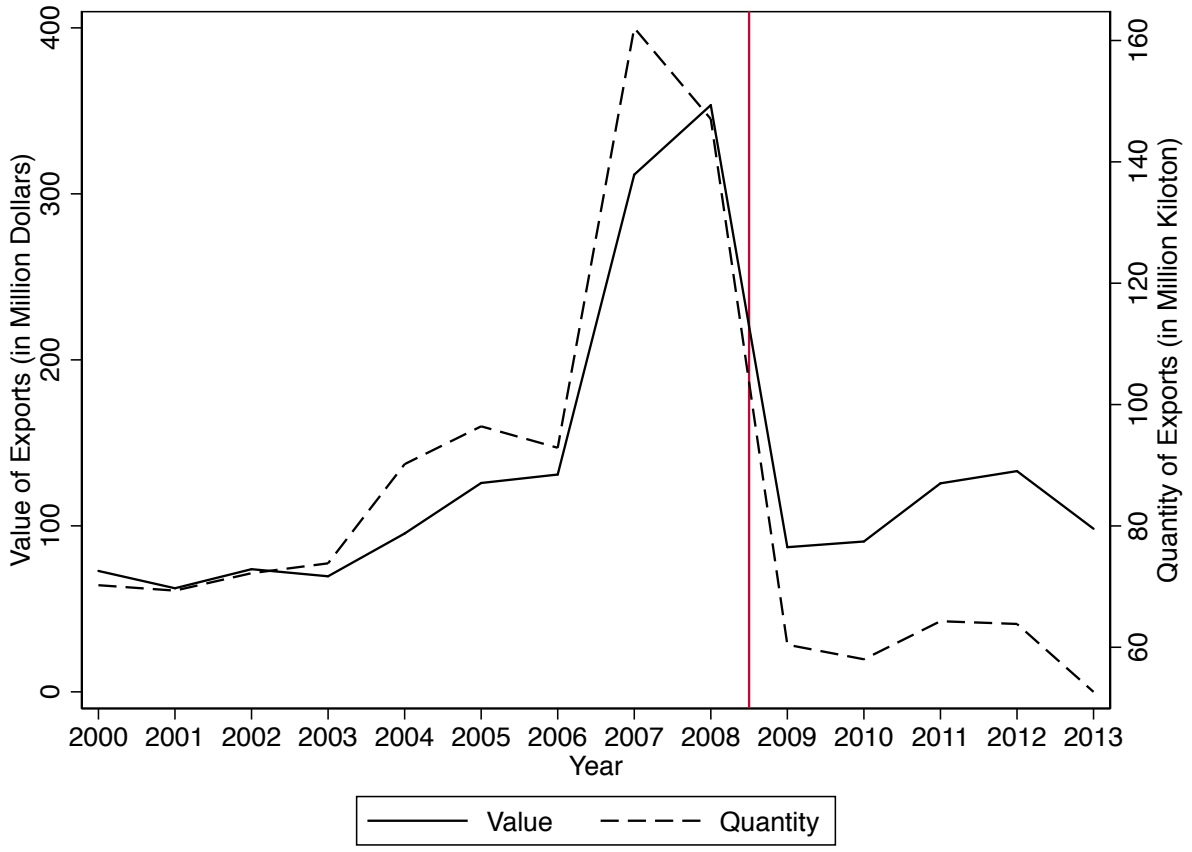
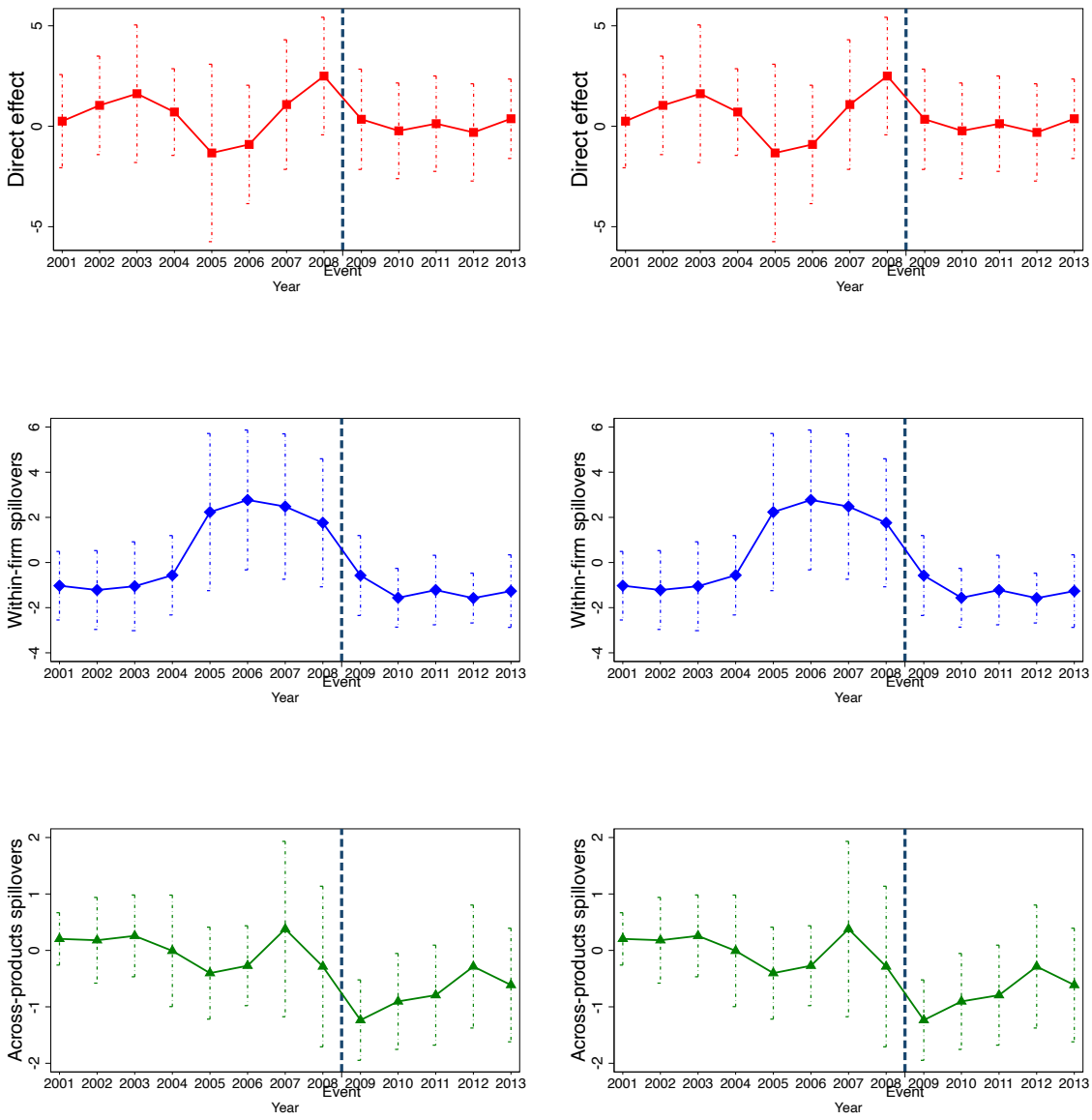
Figure 1: Event Study Graph: China's Dairy Exports



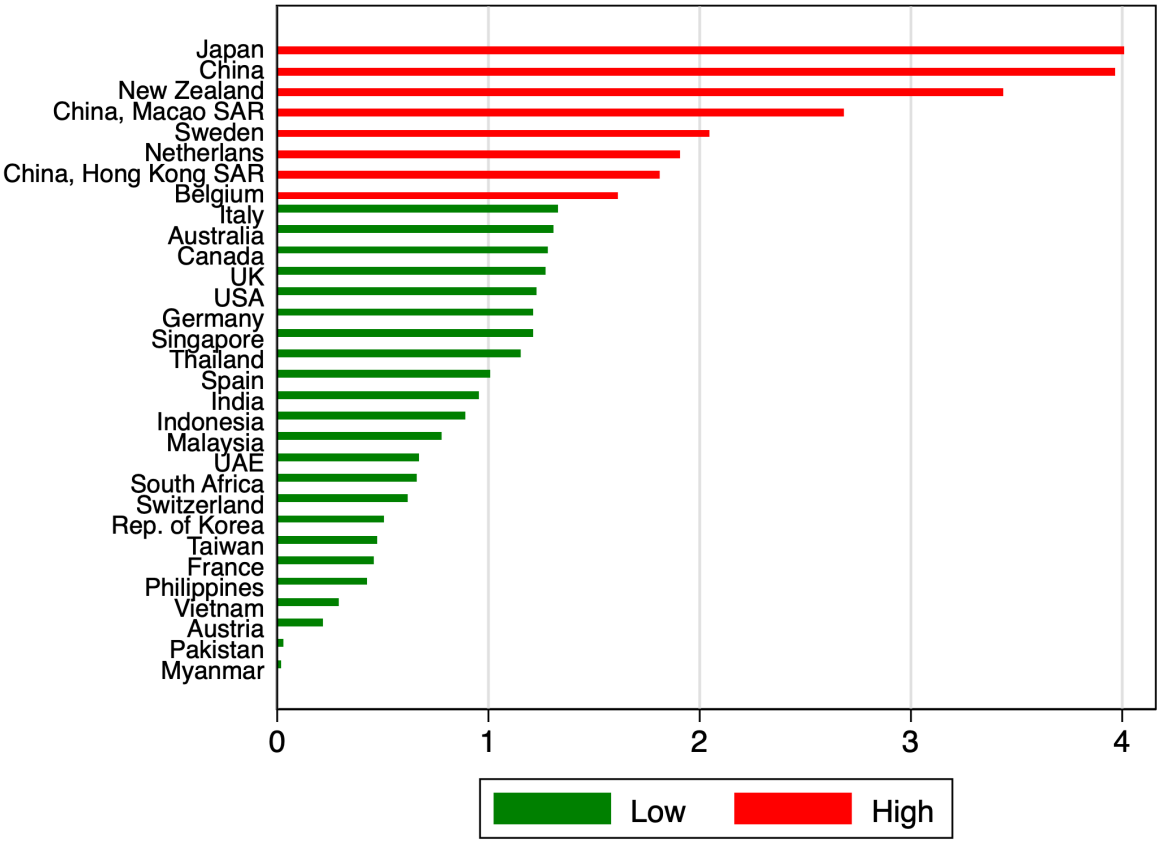
Notes: This figure plots Chinese dairy export values and quantities from 2000 to 2013.

Figure 2: Effects over Time: Export Value (Left) and Export Dummy (Right)



Notes: This figure plots the regression coefficients of the following three group dummies interacted with year dummies: ContaminatedFirm-Product, ContaminatedFirm and ContaminatedProduct. The same regressions also include the interaction terms between year dummies and InnocentFirm-Product as well as InnocentFirm dummies; these coefficients are not plotted. The outcome variable for the left column is the inverse hyperbolic sine (IHS) transformation of export value, and the one for the right column is the export dummy. All regressions include firm-product and year fixed effects. The dotted lines plot the 95% confidence intervals, based on two-way clustered standard errors at the firm and product-year level.

Figure 3: Ratio of Google Search Index: "Sanlu" versus "2008 Chinese Milk Scandal"



Notes: This figure plots the ratio of the Google search index for the keyword "Sanlu" versus "2008 Chinese milk scandal" by country between 09/01/2008 and 10/31/2008. The orange bars mark countries with high information accuracy (the top quartile), while the green ones mark countries with low information accuracy.

Table 1: Baseline Summary Statistics: Dairy Firms

	Contaminated		Innocent		Uninspected		Contaminated vs. Uninspected	
	Number	Mean	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Customs Database								
Avg. yearly export revenue	15	3.30	23	.50	960	1.85	1.45	.349
(in million dollars)	.	(6.15)	.	(.91)	.	(6.62)	(1.55)	.
Years of exporting	15	4.80	23	3.22	960	4.22	.58	.421
	.	(2.86)	.	(2.32)	.	(2.43)	(.72)	.
% exports to OECD countries	15	.49	23	.39	960	.60	-.11	.299
(conditioning on exporting)	.	(.43)	.	(.42)	.	(.39)	(.11)	.
Panel B. Manufacturing Survey								
Employment	38	955	284	280	1407	177	778	.002
	.	(1573)	.	(451)	.	(294)	(252)	.
Log (employment)	38	5.73	284	5.04	1393	4.55	1.18	0
	.	(1.45)	.	(.94)	.	(1.05)	(.23)	.
Sales revenue (in million RMB)	36	982	264	112	880	73	909	.008
	.	(2074)	.	(235)	.	(165)	(341)	.
Log (sales revenue)	36	5.05	263	3.71	867	3.14	1.91	0
	.	(2.01)	.	(1.28)	.	(1.45)	(.33)	.

Notes: For each firm, the sample includes only dairy products. Panel A uses the baseline (2000-2007) Customs database linked with the inspection list to identify contaminated, innocent and uninspected firms. Panel B uses the baseline (2005-2007) Manufacturing Survey data, also linked with the inspection list. The unit of observation is collapsed to the firm level. Columns 1, 3, and 5 show the number of firms in each category. Columns 2, 4, and 6 show the mean of selected variables in each subsample. For these variables, Column 7 calculates the difference between contaminated firms (Column 2) and uninspected firms (Column 6), obtained by regressing the outcome variable on a contaminated group dummy. Column 8 presents the p-value of the difference. Standard deviations are in parentheses for Columns 2, 4 and 6. For Column 7, robust standard errors are in parentheses.

Table 2: Baseline Summary Statistics: Dairy and Dairy-related Products

	Contaminated		Innocent+Uninspected			
	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A. Dairy Products			
Avg. yearly export revenue	11	6.36	12	3.99	2.37	.542
(in million dollars)	.	(11.12)	.	(6.41)	(3.83)	.
Number of exporting years	11	7.64	12	6.42	1.22	.086
	.	(1.21)	.	(1.98)	(.68)	.
% to OECD countries	11	.55	12	.65	-.10	.437
	.	(.25)	.	(.33)	(.12)	.
			Panel B. Non-dairy Food Products			
Avg. yearly export revenue	16	38.53	944	21.23	17.30	.168
(in million dollars)	.	(51.01)	.	(67.02)	(12.55)	.
Number of exporting years	16	7.88	944	6.09	1.79	0
	.	(.50)	.	(2.51)	(.15)	.
% to OECD countries	16	.80	944	.76	.04	.204
	.	(.13)	.	(.26)	(.03)	.

Notes: The sample is obtained from the baseline (2000-2007) Customs database linked with the inspection list to identify contaminated, innocent and uninspected products. Panel A only includes dairy products, while Panel B includes non-dairy food products. The unit of observation is collapsed to the product (HS eight-digit) level. Columns 1 and 3 show the number of products (HS eight-digit) in each category. Columns 2 and 4 show the mean of selected variables in each subsample. Column 5 calculates the difference between contaminated products (Column 2) and innocent plus uninspected products (Column 4), obtained by regressing the outcome variable on a contaminated group dummy. Column 6 presents the p-value of the difference. Standard deviations are in parentheses for Columns 2 and 4. For Column 5, robust standard errors are in parentheses.

Table 3: Impact of the Scandal on Exports: Industry-Level Analysis

Dep Var: Log (Export Value)	(1)	(2)	(3)	(4)
Panel A. All Dairy Exports				
DairyXPost	-1.065***	-0.892***	-0.685***	-1.140***
	(0.080)	(0.114)	(0.238)	(0.086)
FoodXPost		-0.174		
		(0.139)		
R-squared	0.964	0.963	0.970	0.980
Observations	1120	1386	1107	1120
Panel B. Innocent+Uninspected Firm-Products Only				
DairyXPost	-0.915***	-0.741***	-0.554**	-0.848***
	(0.080)	(0.114)	(0.233)	(0.086)
FoodXPost		-0.174		
		(0.139)		
R-squared	0.964	0.963	0.970	0.980
Observations	1120	1386	1107	1120
Year, Industry FEs	YES	YES	YES	YES
YearXValue Share to different continents	NO	NO	YES	NO
Industry time trends	NO	NO	NO	YES
Excluding the food sector	YES	NO	YES	YES

Notes: This table shows the regression results for Equation 1. Panel A contains all exporters, collapsed to the industry-year level. Panel B excludes contaminated firm-products to quantify the aggregate spillover effect. We create a balanced panel at the industry (HS two-digit) and year level. The dependent variable is log annual export value for each industry. The baseline specification in Column 1 includes only year and industry fixed effects. Columns 3 and 4 build on this specification by adding time-varying controls, including the value share exported to different continents at baseline (2000-2007) interacted with year indicators and industry-specific linear time trends. Columns 1, 3 and 4 exclude non-dairy food industries; Column 2 includes all HS two-digit industries. Standard errors clustered at the product (HS two-digit) level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table 4: Impact of the Scandal on Exports: Firm-Product-Level Analysis

	IHS (Value)	IHS (Quantity)	Log (Price)	Exporting (dummy)
	(1)	(2)	(3)	(4)
CFirm-ProductXPost	-0.489	-0.345	-0.122	-0.019
	(1.180)	(1.157)	(0.091)	(0.078)
CFirmXPost	-1.838***	-1.811***	0.209***	-0.153***
	(0.437)	(0.456)	(0.051)	(0.031)
CProductXPost	-0.773***	-0.757***	-0.157*	-0.064***
	(0.281)	(0.257)	(0.087)	(0.023)
IFirm-ProductXPost	1.083	0.981	-0.211**	0.081
	(0.978)	(0.929)	(0.083)	(0.071)
IFirmXPost	-0.944	-0.847	0.219**	-0.081
	(0.768)	(0.708)	(0.097)	(0.063)
R-squared	0.285	0.299	0.903	0.211
Observations	13775	13775	1519	13775
Firm-product FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES

Notes: This table shows the regression results for Equation 2. The unit of observation is at the firm-product-year level. The sample contains all dairy exporters (excluding intermediaries) in the Chinese Customs data (2000-2013). We rectangularize the data to create a balanced panel at the firm-product (HS eight-digit) and year level for the outcomes in Columns 1, 2 and 4. Columns 1 and 2 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, export value and export quantity. Column 3 presents results for the natural logarithm of unit price, while Column 4 uses an indicator for positive exports as the outcome variable. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category includes innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export volume. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table 5: Impact of the Scandal on Firms' Domestic Performance

	Log (Total sales revenue)	Log (Domestic sales revenue)	Log (Employment)
	(1)	(2)	(3)
CFirmsXPost	-0.315	-0.309	-0.181
	(0.255)	(0.255)	(0.235)
IFirmsXPost	-0.036	-0.027	-0.099
	(0.089)	(0.091)	(0.067)
R-squared	0.884	0.882	0.839
Observations	1664	1665	1666
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
BaselineSizeXPost	YES	YES	YES

Notes: This table shows the regression results for the effects of the scandal on firms' sales and employment. The unit of observation is at the firm-year level. The sample includes the balanced sample of dairy firms in the Manufacturing Survey data (2005-2009 and 2011-2013). We compute a firm's domestic sales by subtracting export sales from total sales; in cases where export information is missing in the Manufacturing Survey data, we merge the sample with the Customs data and fill in the missing export sales information whenever we can. The interaction terms are the post-scandal indicator (2009-2013) with the following two group indicators: (C)ontaminatedFirm and (I)nnocentFirm. The omitted category is uninspected firms. All regressions include firm and year fixed effects. Baseline size measures a firm's total sales revenue from 2005 to 2007. Standard errors are clustered at the firm level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table 6: Heterogeneous Impact Based on the Google Search Index

	IHS (Value)			IHS (Quantity)			Exporting (dummy)		
	High	Low	Rest	High	Low	Rest	High	Low	Rest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CFirm-ProductXPost	-1.101	-0.068	-0.208	-0.958	-0.026	-0.180	-0.061	0.005	-0.014
	(1.391)	(0.963)	(0.452)	(1.349)	(0.929)	(0.420)	(0.094)	(0.062)	(0.033)
CFirmXPost	-0.571	-1.678***	-0.739***	-0.650	-1.585***	-0.690***	-0.055	-0.132***	-0.062***
	(0.639)	(0.595)	(0.230)	(0.657)	(0.586)	(0.219)	(0.047)	(0.049)	(0.018)
CProductXPost	-0.025	-0.639***	-0.367***	-0.057	-0.591***	-0.341***	-0.001	-0.053***	-0.031***
	(0.153)	(0.195)	(0.141)	(0.138)	(0.183)	(0.130)	(0.013)	(0.016)	(0.011)
IFirm-ProductXPost	0.391	0.713	0.676	0.363	0.649	0.621	0.023	0.047	0.062
	(0.496)	(0.756)	(0.543)	(0.494)	(0.723)	(0.513)	(0.038)	(0.059)	(0.042)
IFirmXPost	-0.259	-0.452	-0.810	-0.231	-0.410	-0.725	-0.026	-0.035	-0.069
	(0.368)	(0.382)	(0.637)	(0.362)	(0.346)	(0.592)	(0.037)	(0.031)	(0.049)
R-squared	0.418	0.294	0.255	0.440	0.296	0.254	0.341	0.242	0.224
Observations	13775	13775	13775	13775	13775	13775	13775	13775	13775
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal across export destinations with different information accuracy. The unit of observation is at the firm-product-year level. The sample contains all dairy exporters in the Chinese Customs data (2000-2013). We create a balanced panel at the firm-product (HS eight-digit) and year level. Columns 1-6 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, export value and export quantity. Columns 7-9 use an indicator for positive exports as the outcome variable. We categorize export destinations by high and low information accuracy, using the Google search intensity ratio. High-information-accuracy destinations display a high ratio of searches for the word "Sanlu" relative to searches for "2008 Chinese milk scandal". We also include results for countries without a Google search index ("Rest"). The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01 level, ** at the 0.5, and * at the 0.1 level.

Table 7: Heterogeneous Impact by Firms' Sourcing Location

	IHS (Value)	IHS (Quantity)	Log (Price)	Exporting (dummy)
	(1)	(2)	(3)	(4)
CProductXPost	-0.587**	-0.551**	-0.164	-0.045**
	(0.274)	(0.259)	(0.110)	(0.021)
CSourceCity-ProductXPost	0.030	0.050	0.053	0.023
	(0.554)	(0.520)	(0.096)	(0.045)
CSourceCityXPost	-0.090	-0.113	0.027	-0.002
	(0.274)	(0.257)	(0.083)	(0.022)
R-squared	0.313	0.319	0.898	0.248
Observations	8768	8768	1098	8768
Firm-product FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal on exports across firms with different baseline sourcing locations. The unit of observation is at the firm-product-year level. The sample contains innocent and uninspected dairy exporters in the Chinese Customs data (2000-2013). We create a balanced panel at the firm-product (HS eight-digit) and year level for the outcomes in Columns 1, 2, and 4. Columns 1 and 2 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, export value and export quantity. Column 3 presents results for the natural logarithm of unit price, while Column 4 uses an indicator for positive exports as the outcome variable. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following three group indicators: (C)ontaminatedProduct, (C)ontaminatedSourceCity-Product and (C)ontaminatedSourceCity. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the product-year and firm level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table 8: Heterogeneous Impact by Firms' Export Experience

	IHS (Value)				Exporting (dummy)			
	Established	New	Established	New	Established	New	Established	New
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CFirm-ProductXPost	-0.678	-1.251***	-0.760	-0.943***	-0.032	-0.091***	-0.036	-0.068*
	(1.419)	(0.433)	(1.423)	(0.332)	(0.092)	(0.034)	(0.092)	(0.039)
CFirmXPost	-1.119**	-2.098***	-1.069**	-2.112**	-0.084**	-0.190***	-0.082**	-0.192***
	(0.502)	(0.712)	(0.508)	(0.832)	(0.035)	(0.063)	(0.035)	(0.073)
CProductXPost	-0.390	-1.520***	-0.214	-1.160***	-0.034	-0.115***	-0.026	-0.089***
	(0.358)	(0.438)	(0.411)	(0.382)	(0.028)	(0.034)	(0.033)	(0.030)
IFirm-ProductXPost	-0.456	2.979*	-0.463	2.787	-0.026	0.199*	-0.026	0.185
	(0.831)	(1.764)	(0.821)	(1.843)	(0.061)	(0.120)	(0.060)	(0.126)
IFirmXPost	-0.597	-1.714	-0.583	-1.375	-0.047	-0.147	-0.048	-0.122
	(0.798)	(1.209)	(0.794)	(1.209)	(0.067)	(0.093)	(0.067)	(0.093)
R-squared	0.339	0.228	0.340	0.230	0.252	0.206	0.253	0.208
Observations	9830	3945	9830	3945	9830	3945	9830	3945
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES
HS2digitXYear	YES	YES	NO	NO	YES	YES	NO	NO
H2digitXPost	NO	NO	YES	YES	NO	NO	YES	YES

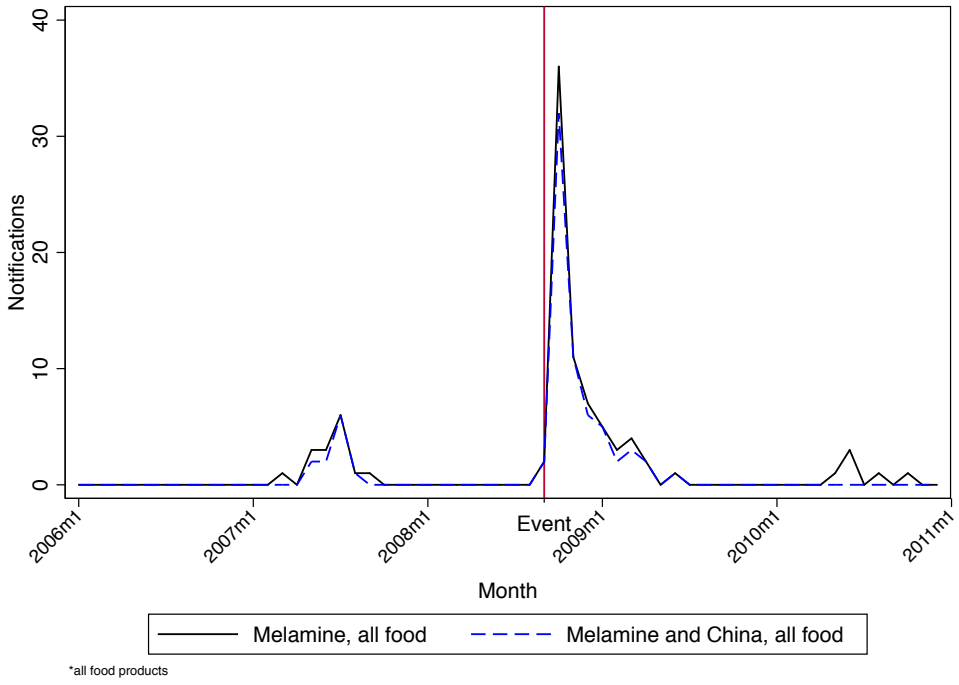
Notes: This table shows the regression results for the heterogeneous effects of the scandal on exports across firms with different lengths of export experience. The unit of observation is at the firm-product-year level. The sample contains all dairy exporters in the Chinese Customs data (2000-2013). We create a balanced panel at the firm-product (HS eight-digit) and year level. Columns 1-4 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variable of interest, export value. Columns 5-8 use an indicator for positive exports as the outcome variable. Columns 1, 3, 5, and 7 use the subsample of established firms, which are firms that had exported for more than 1 year before 2008. Columns 2, 4, 6, and 8 use the subsample of new firms, which are firms that had not exported before 2008. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

APPENDICES

- Appendix A: Additional Tables and Figures
- Appendix B: Data Appendix and Codebooks
- Appendix C: Alternative Empirical Strategies for the Industry-Level Analysis

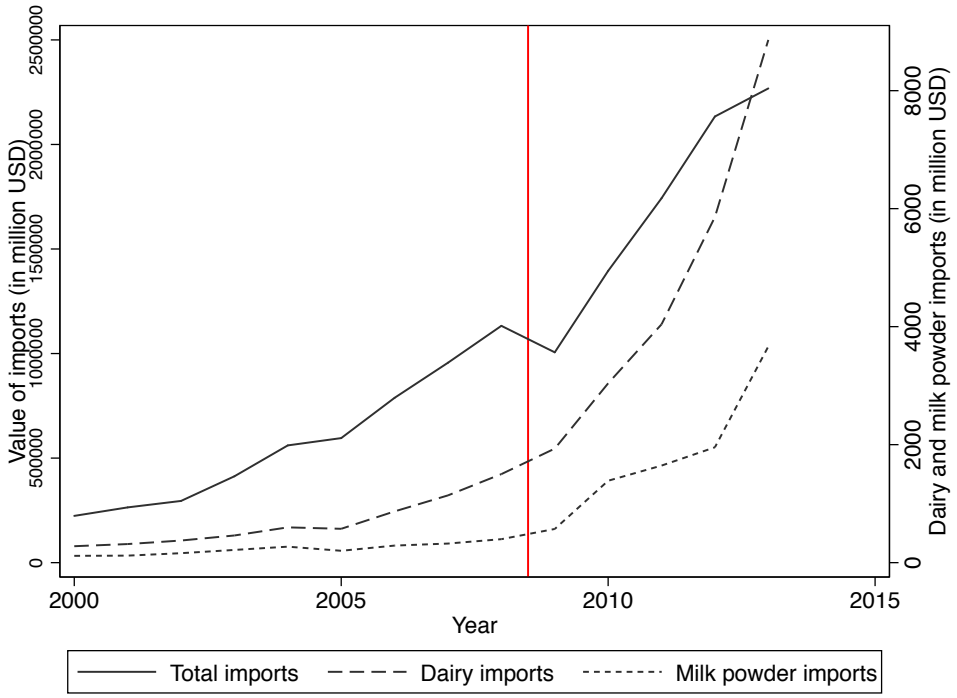
Appendix A: Additional Tables and Figures

Figure A.1: Number of Melamine Notifications (RASFF, 2006-2010)



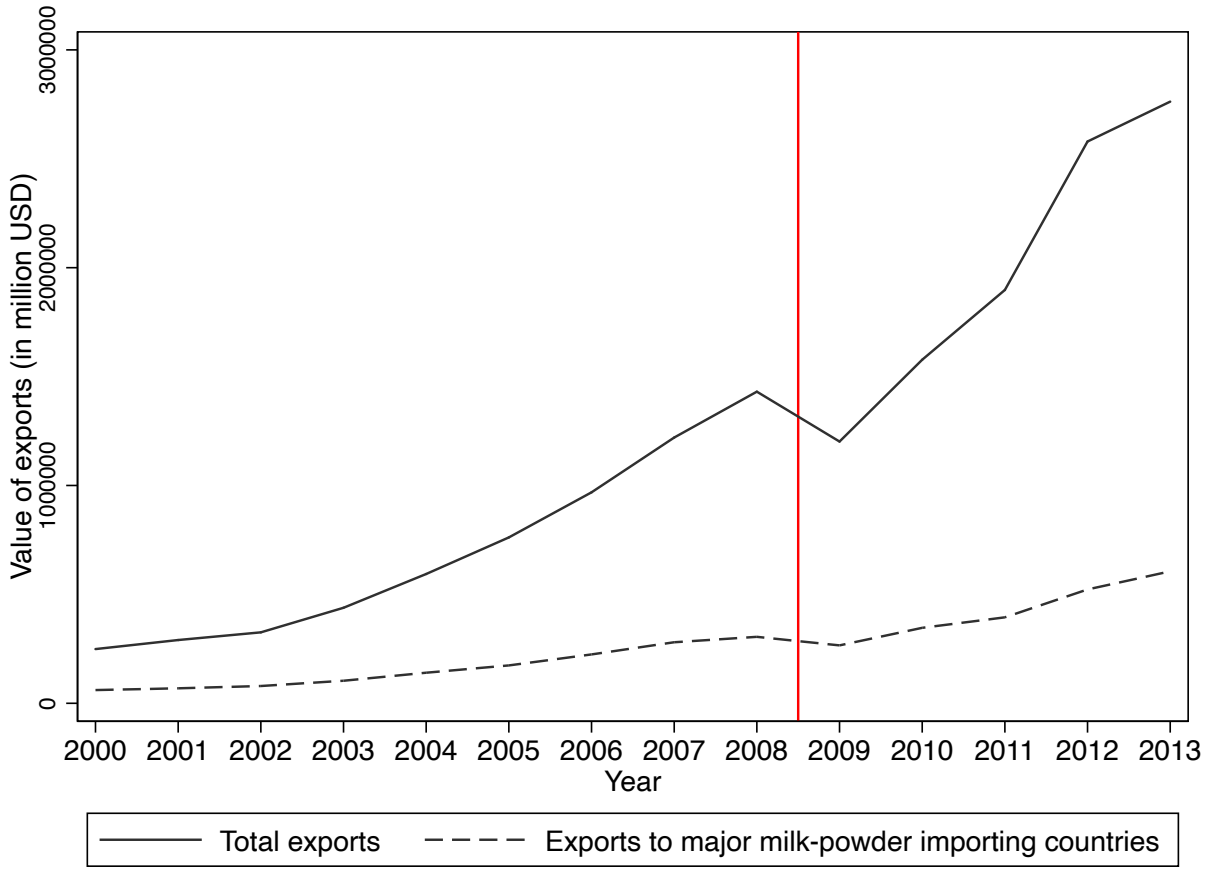
Notes: This figure plots the total number of safety notifications regarding melamine for imported food products and the number of melamine notifications specific to China in the Rapid Alert System for Food and Feed (RASFF). The red line represents the month of the initial outbreak of the scandal: September 2008. The RASFF is a system for reporting food safety issues in the European Union.

Figure A.2: China's Import Growth over Time



Notes: This figure plots the value of all Chinese imports as well as imports of dairy products and milk powder from 2000 to 2013.

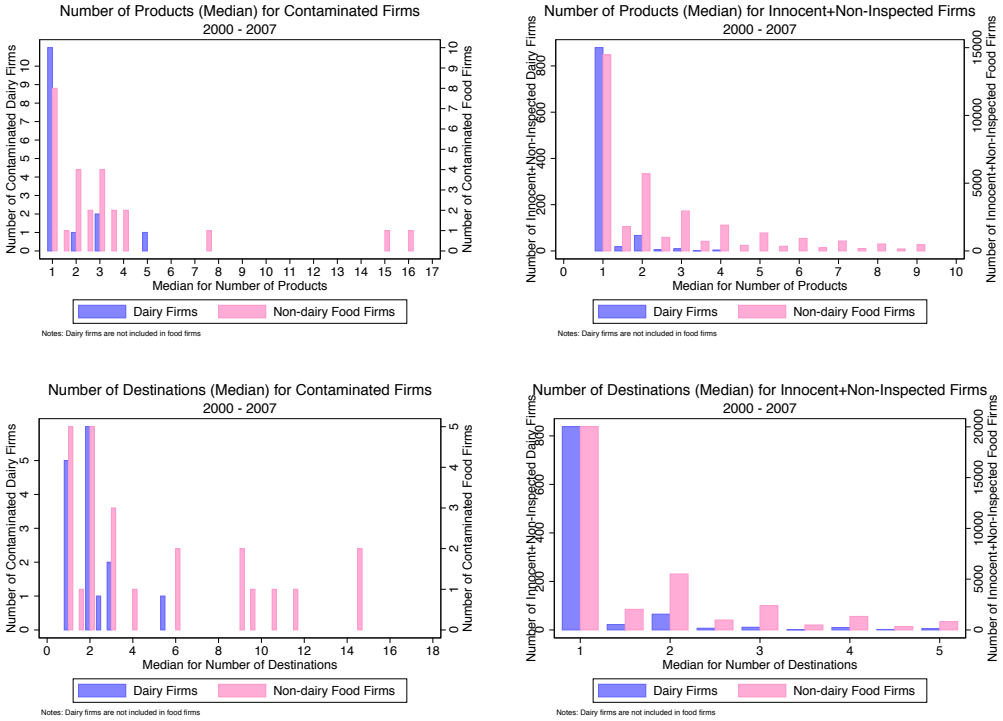
Figure A.3: China's Export Growth over Time



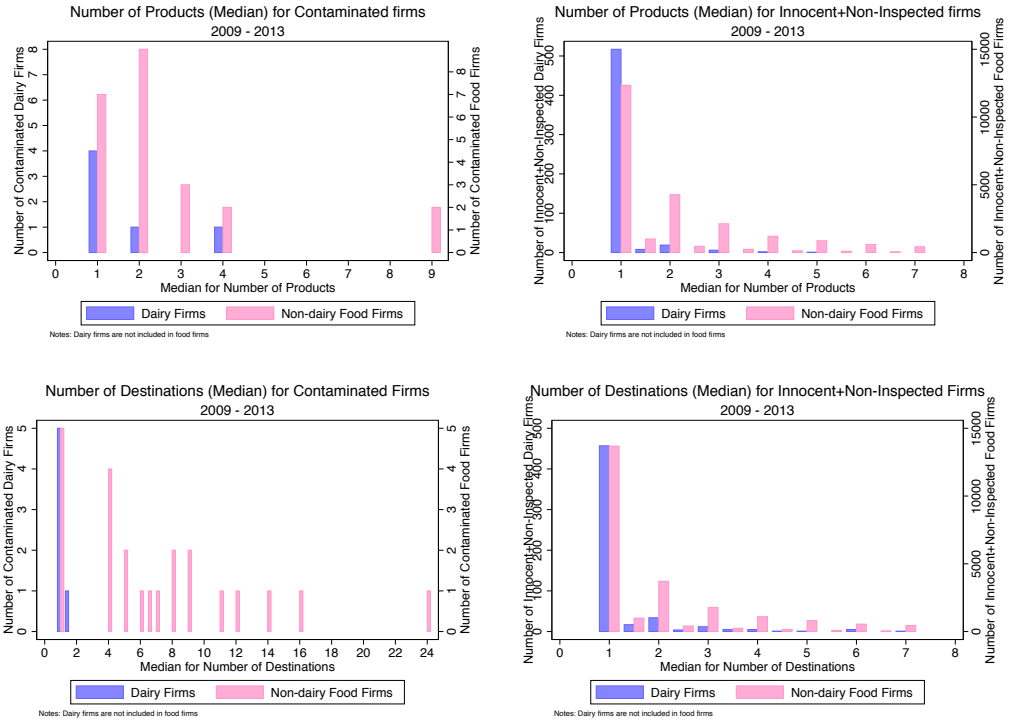
Notes: This figure plots the value of all Chinese exports and the value of exports to major milk powder-importing countries from China (including Taiwan, Hong Kong, Singapore, Thailand, Iraq, Bangladesh, Burma, the Philippines and UAE).

Figure A.4: Number of Export Products and Destinations across Firms

Panel A. Before the Scandal: 2000-2007

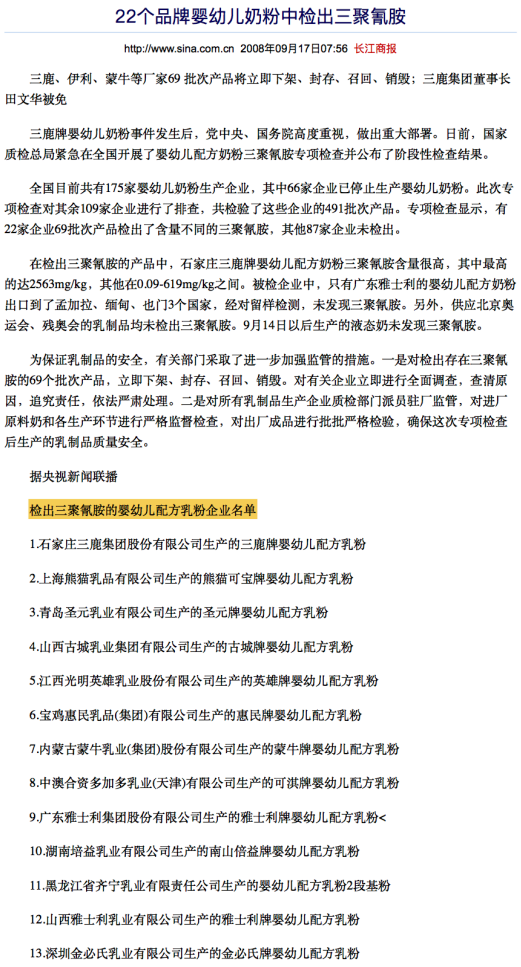


Panel B. After the Scandal: 2009-2013



Notes: This figure plots number of firms with different median numbers of products and numbers of destinations in the pre-scandal (Panel A) and post-scandal (Panel B) periods. Contaminated firms appear in the left column and innocent plus uninspected firms in the right column. Dairy firms are defined as firms that ever exported dairy products between 2000 and 2013, while non-dairy food firms are defined as firms that exported food products but never exported dairy products between 2000 and 2013.

Figure A.5: Examples of News Reports in Domestic and Foreign Countries



22个品牌婴幼儿奶粉中检出三聚氰胺

http://www.sina.com.cn 2008年09月17日07:56 长江商报

三鹿、伊利、蒙牛等厂家69 批次产品将立即下架、封存、召回、销毁；三鹿集团董事长田文华被免

三鹿牌婴幼儿奶粉事件发生后，党中央、国务院高度重视，做出重大部署。日前，国家质检总局紧急在全国开展了婴幼儿配方奶粉三聚氰胺专项检查并公布了阶段性检查结果。

全国目前共有175家婴幼儿奶粉生产企业，其中66家企业已停止生产婴幼儿奶粉。此次专项检查对其余109家企业进行了排查，共检验了这些企业的491批次产品。专项检查显示，有22家企业69批次产品检出了含量不同的三聚氰胺，其他87家企业未检出。

在检出三聚氰胺的产品中，石家庄三鹿牌婴幼儿配方奶粉三聚氰胺含量很高，其中最高的达2563mg/kg，其他在0.09-619mg/kg之间。被检企业中，只有广东雅士利的婴幼儿配方奶粉出口到了孟加拉、缅甸、也门3个国家，经对留样检测，未发现三聚氰胺。另外，供应北京奥运会、残奥会的乳制品均未检出三聚氰胺。9月14日以后生产的液态奶未发现三聚氰胺。

为保证乳制品的安全，有关部门采取了进一步加强监管的措施。一是对检出存在三聚氰胺的69个批次产品，立即下架、封存、召回、销毁。对有关企业立即进行全面调查，查清原因，追究责任，依法严肃处理。二是对所有乳制品生产企业质检部门派员驻厂监管，对进厂原料奶和各生产环节进行严格监督检查，对出厂成品进行批批严格检验，确保这次专项检查后生产的乳制品质量安全。

据央视新闻联播

检出三聚氰胺的婴幼儿配方乳粉企业名单

1.石家庄三鹿集团股份有限公司生产的三鹿牌婴幼儿配方乳粉

2.上海熊猫乳品有限公司生产的熊猫可宝牌婴幼儿配方乳粉

3.青岛圣元乳业有限公司生产的圣元牌婴幼儿配方乳粉

4.山西古城乳业集团有限公司生产的古城牌婴幼儿配方乳粉

5.江西光明英雄乳业股份有限公司生产的英雄牌婴幼儿配方乳粉

6.宝鸡惠民乳品(集团)有限公司生产的惠民牌婴幼儿配方乳粉

7.内蒙古蒙牛乳业(集团)股份有限公司生产的蒙牛牌婴幼儿配方乳粉

8.中澳合资多加多乳业(天津)有限公司生产的可淇牌婴幼儿配方乳粉

9.广东雅士利集团股份有限公司生产的雅士利牌婴幼儿配方乳粉<

10.湖南培益乳业有限公司生产的南山倍益牌婴幼儿配方乳粉

11.黑龙江省齐宁乳业有限责任公司生产的婴幼儿配方乳粉2段基粉

12.山西雅士利乳业有限公司生产的雅士利牌婴幼儿配方乳粉

13.深圳金必氏乳业有限公司生产的金必氏牌婴幼儿配方乳粉

The New York Times

ASIA PACIFIC

China Says More Milk Products Show Signs of Being Tainted

By EDWARD WONG SEPT. 18, 2008

BEIJING — China's adulterated-milk scandal continued to widen Thursday, as the authorities arrested a dozen people, fired a senior government official and acknowledged that a wider range of milk products showed traces of a chemical used to disguise its poor quality.

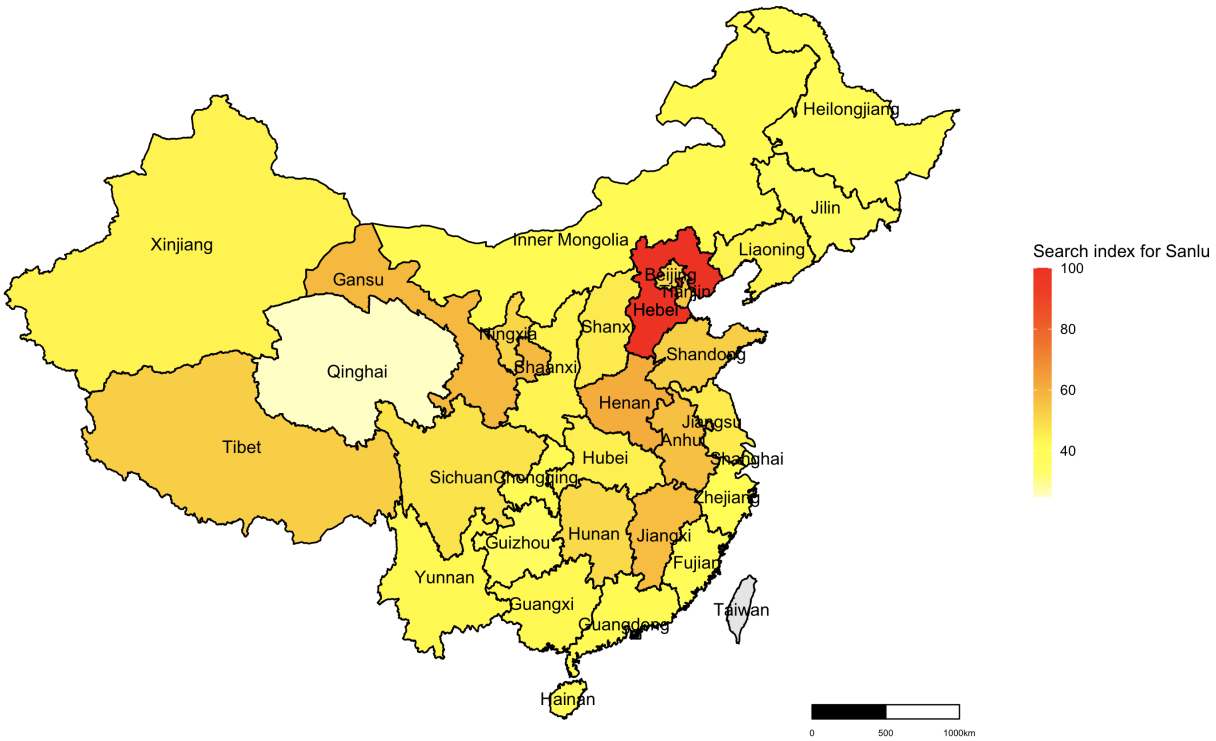
Officials said a fourth infant had died from tainted baby formula, while health regulators in Hong Kong announced a broader recall of mainland Chinese-made milk, yogurt and ice cream contaminated with the chemical melamine.

Tainted milk is the latest in a long string of food and drug safety problems that have caused consumers in China and in the country's major export markets to worry about the quality of some Chinese goods.

Tainted infant formula was at the center of another scandal in 2004 that prompted a crackdown on rogue suppliers. But the new safety problems are much more widespread, involving at least 22 dairy companies and contaminated milk products that have appeared nationwide.

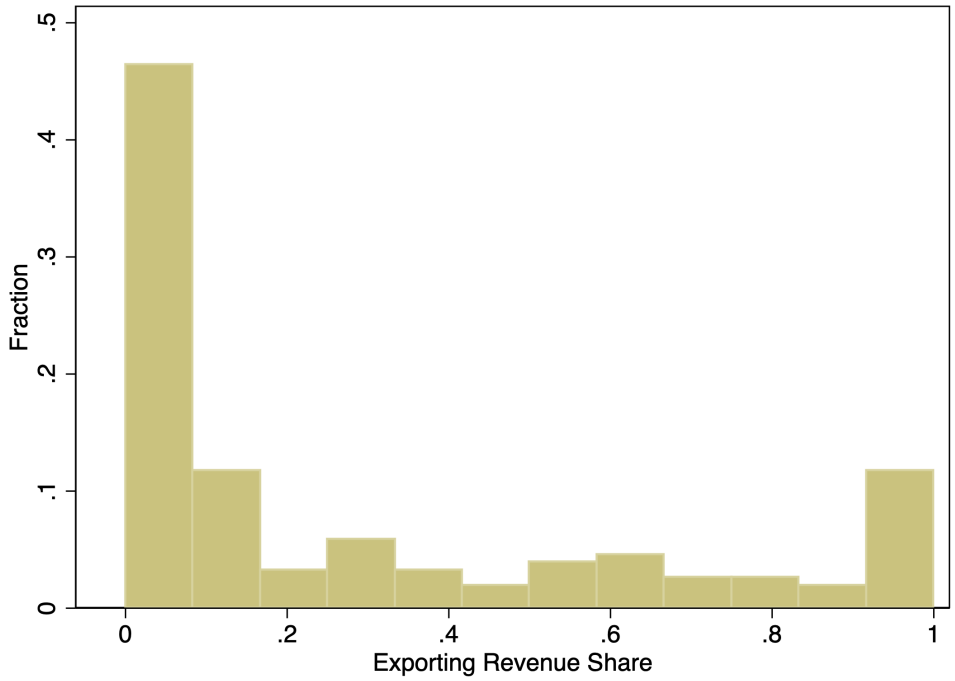
Notes: The figure in the left panel shows a Chinese news report on the results of the first round of inspections. The figure on the right is a typical article in foreign media reporting the same news. Chinese news media usually provided a full list of contaminated firms, while foreign news outlets usually did not. The firms mentioned in Chinese news outlets include Shijiazhuang Sanlu Group, Shanghai Panda Dairy, Qingdao Shengyuan Dairy, Shanxi Gu Cheng Dairy, Jiangxi Guangming Yingxiong Dairy, Baoji Huimin Dairy, Inner Mongolia Mengniu Dairy, Torador Dairy Industry (Tianjin), Guangdong Yashili Group, Hunan Peiyi Dairy, Heilongjiang Qilin Dairy, Shanxi Yashili Dairy, Shenzhen Jinbishi Milk, Scient (Guangzhou) Infant Nutrition, Guangzhou Jinding Dairy Products Factory, Inner Mongolia Yili Industrial Group, Yantai Ausmeadow Nutriment, Qingdao Suncare Nutritional Technology, Xi'an Baiyue Dairy, Yantai Leilei Dairy, Shanghai Baoanli Dairy, and Fuding Chenguan Dairy.

Figure A.6: Google Search Index across Provinces in China



Notes: This figure plots the Google search index for the term "Sanlu" across provinces in China in 2008.

Figure A.7: Histogram of Baseline Export Revenue Share



Notes: This figure plots the histogram of the baseline (2007) export revenue share in total sales revenue for dairy firms in the Manufacturing Survey data that can be matched to the Chinese Customs data.

Table A.1: Baseline Summary Statistics: Non-Dairy Food Industry

	Contaminated		Innocent		Uninspected		Contaminated vs. Uninspected	
	Number	Mean	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A. Customs Database				
Avg. yearly export revenue	26	2.91	19	.58	37264	.55	2.35	.014
(in million dollars)	.	(4.98)	.	(1.01)	.	(3.69)	(.96)	.
Years of exporting	26	5.23	19	4.32	37264	2.75	2.48	0
	.	(2.44)	.	(2.34)	.	(2.05)	(.47)	.
% exports to OECD countries	26	.68	19	.57	37264	.69	-.01	.929
(conditioning on exporting)	.	(.32)	.	(.40)	.	(.40)	(.06)	.
				Panel B. Manufacturing Survey				
Employment	23	920	30	402	24239	174	746	.025
	.	(1629)	.	(822)	.	(436)	(332)	.
Log (employment)	23	5.94	29	5.31	23849	4.40	1.54	0
	.	(1.25)	.	(1.06)	.	(1.15)	(.26)	.
Sales revenue (in million RMB)	19	268	19	242	13164	61	207	.039
	.	(450)	.	(543)	.	(256)	(100)	.
Log (sales revenue)	19	4.61	19	3.96	12850	2.91	1.70	0
	.	(1.51)	.	(1.70)	.	(1.45)	(.34)	.

Notes: Panel A is obtained from the baseline (2000-2007) Customs database linked with the inspection list to identify contaminated, innocent and uninspected firms. Panel B is obtained from the baseline (2005-2007) Manufacturing Survey, which is also linked with the inspection list. The unit of observation is collapsed to the firm level. Columns 1, 3 and 5 show the number of firms that fall into each category. Column 7 is the difference between contaminated firms (Column 2) and uninspected firms (Column 6), obtained through a simple regression of the outcome variable on a contaminated group dummy. Column 8 is the p-value of the difference. Standard deviations are in parentheses for Columns 2, 4 and 6. For Column 7, robust standard errors are in parentheses.

Table A.2: Balance Check for the Second Round of Inspections

	Inspected		Uninspected			
	Number	Mean	Number	Mean	Difference	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Export Performance						
Total value of milk powder exported in 2007	8	7.60	196	.43	7.17	0
(in million dollars)	.	(19.91)	.	(1.78)	(1.48)	.
Total value of milk powder exported to OECD countries in 2007	8	1.27	196	0.02	1.25	0
(in million dollars)	.	(3.45)	.	(0.27)	(0.25)	.
Total quantity of milk powder exported in 2007	8	2.52	196	0.16	2.36	0
(in million kiloton)	.	(6.52)	.	(0.65)	(0.49)	.
Total quantity of milk powder exported to OECD countries in 2007	8	0.44	196	0.01	0.43	0
(in million kiloton)	.	(1.21)	.	(0.12)	(0.09)	.
Avg. price of exported milk powder in 2007	6	3.00	62	2.76	.24	.591
	.	(.40)	.	(1.09)	(.45)	.
Avg. price of milk powder exported to OECD countries in 2007	2	2.60	12	2.76	-.16	.862
	.	(.43)	.	(1.19)	(.87)	.
Baseline total export value (2000-2007)	8	26.92	196	77.74	-50.82	.672
(in million dollars)	.	(58.73)	.	(337.93)	(119.83)	.
Baseline number of exporting years (2000-2007)	8	3	196	3.43	-.43	.665
	.	(2.97)	.	(2.76)	(1.00)	.
Exported for more than 1 year prior to 2008 (dummy)	8	.5	196	.66	-.16	.360
	.	(.54)	.	(.48)	(.17)	.
Panel B. Domestic Performance						
Private Enterprise (dummy)	88	.30	827	.40	-.10	.050
	.	(.46)	.	(.49)	(.05)	.
Employment	88	596	827	230	366	.025
	.	(1535)	.	(423)	(163)	.
Log (employment)	88	5.07	827	4.81	.26	.092
	.	(1.42)	.	(1.06)	(.16)	.
Sales revenue	88	418	820	138	279	.072
(in million RMB)	.	(1452)	.	(418)	(155)	.
Log (sales revenue)	88	4.06	820	3.76	.30	.114
	.	(1.72)	.	(1.42)	(.19)	.

Notes: Panel A is obtained from the baseline (2000-2007) Customs database linked with the inspection list to identify inspected and uninspected firms in the second round of government inspections. Panel B is obtained from the baseline (2005-2007) Manufacturing Survey, which is also linked with the inspection list. The unit of observation is collapsed to the firm level. Columns 1 and 3 show the number of firms that fall into each category in the second round of inspections. Column 5 is the difference between inspected firms (Column 2) and uninspected firms (Column 4), obtained through a simple regression of the outcome variable on an inspected group dummy. Column 6 is the p-value of the difference. Standard deviations are in parentheses in Columns 2 and 4. In Column 5, robust standard errors are in parentheses.

Table A.3: Impact of the Scandal on Imports: Industry-Level Analysis

Dep Var: Log (Import Value)	(1)	(2)	(3)
Dairy, Post Scandal	0.912***	0.559***	0.419***
	(0.077)	(0.082)	(0.059)
Food, Post Scandal		0.353***	
		(0.112)	
Observations	1106	1372	1106
Year, Industry FEs	YES	YES	YES
Industry time trends	NO	NO	YES
Excluding the food sector	YES	NO	YES

Notes: This table shows the regression results for Equation 1 with log annual import value as the outcome variable. The sample for this analysis includes all importers, collapsed to the industry-year level. We create a balanced panel at the industry (HS two-digit) and year level. The baseline specification in Column 1 includes year and industry fixed effects only. Column 3 builds on this specification by adding industry-specific linear time trends. Columns 1 and 3 exclude non-dairy food industries; Column 2 include all HS two-digit industries. Standard errors are clustered at the industry (HS two-digit) level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table A.4: Robustness Checks of the Firm-Product-Level Analysis

	IHS (Value)	IHS (Quantity)	Log (Price)	Exporting (dummy)
	(1)	(2)	(3)	(4)
Panel A. Alternative Fixed Effects				
CFirm-ProductXPost	1.766	1.806	0.013	0.123
	(1.167)	(1.142)	(0.198)	(0.089)
CFirmXPost	-2.862***	-2.819***	0.240**	-0.218***
	(0.394)	(0.423)	(0.099)	(0.031)
CProductXPost	-0.600**	-0.601**	-0.159	-0.046**
	(0.268)	(0.244)	(0.133)	(0.022)
IFirm-ProductXPost	1.137	1.078	0.004	0.092
	(0.939)	(0.894)	(0.133)	(0.070)
IFirmXPost	-0.857	-0.802	0.275**	-0.084
	(0.792)	(0.726)	(0.129)	(0.063)
Observations	13775	13775	1631	13775
Panel B. Differential Time Trends				
CFirm-ProductXPost	-0.542	-0.389	-0.198*	-0.025
	(1.170)	(1.147)	(0.118)	(0.077)
CFirmXPost	-1.795***	-1.778***	0.304***	-0.148***
	(0.453)	(0.467)	(0.063)	(0.032)
CProductXPost	-0.605*	-0.619**	-0.059	-0.046
	(0.348)	(0.311)	(0.096)	(0.028)
IFirm-ProductXPost	1.068	0.970	-0.197**	0.079
	(0.979)	(0.930)	(0.081)	(0.072)
IFirmXPost	-0.916	-0.828	0.227**	-0.077
	(0.782)	(0.721)	(0.092)	(0.064)
Observations	13775	13775	1519	13775
Panel C. Confounding Demand Shocks				
CFirm-ProductXPost	-0.560	-0.434	-0.121	-0.025
	(1.284)	(1.256)	(0.097)	(0.083)
CFirmXPost	-0.700	-0.792*	0.203***	-0.048
	(0.440)	(0.458)	(0.059)	(0.030)
CProductXPost	-0.516*	-0.480*	-0.160*	-0.038
	(0.288)	(0.270)	(0.096)	(0.023)
IFirm-ProductXPost	0.606	0.546	-0.182*	0.047
	(0.930)	(0.912)	(0.096)	(0.065)
IFirmXPost	-0.168	-0.157	0.223**	-0.008
	(0.689)	(0.640)	(0.108)	(0.058)
Observations	8838	8838	1226	8838

Notes: This table shows results for the same sample as in Table 4. All panels control for baseline size interacted with a post-scandal indicator. The unit of observation is a firm-product-year. Panel A includes firm, product, and province-year fixed effects. Panel B includes firm-product and year fixed effects and controls for linear time trends at the HS two-digit level. Panel C includes firm-product and year fixed effects and controls for firm-specific foreign demand shocks. For each firm, we compute the baseline export value share for each destination country averaged over 2000-2007. For each country-year in the UN Comtrade data, we compute the country's dairy import value excluding Chinese imports. For each firm-year-country, we multiply the country's yearly dairy import value excluding China by the firm's baseline value share for that country. Each year, the firm-specific demand shock is the sum across destination countries. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table A.5: Variation in the Data across Firms, Products and Years

	2000-2007				2009-2013			
	Contaminated Products		Innocent+Uninspected Products		Contaminated Products		Innocent+Uninspected Products	
	Dairy	Non-dairy	Dairy	Non-dairy	Dairy	Non-dairy	Dairy	Non-dairy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Panel A. All Destinations				
Contaminated firms	77	196	41	269	25	132	12	113
Innocent+Uninspected firms	922	17503	1056	481814	353	9516	850	277038
				Panel B. Dropping Destinations with Bans				
Contaminated firms	69	182	34	225	25	123	12	101
Innocent+Uninspected firms	758	13757	610	322554	284	7484	529	191602

Notes: This table shows the number of observations falling into different firm-product-year cells, where products are identified at the HS eight-digit level, for the linked Customs-inspection list sample used for the analysis in Section 5.

Table A.6: Robustness Check of the Firm-Product-Level Analysis: Growth Spike Prior to the Scandal

	IHS (Value)			IHS (Quantity)			Exporting (dummy)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CFirm-ProductXPost	1.024	-0.017	0.355	1.164	0.068	0.490	0.080	-0.014	0.036
	(1.100)	(0.582)	(0.811)	(1.066)	(0.545)	(0.771)	(0.089)	(0.047)	(0.072)
CFirmXPost	-1.986***	-1.972***	-1.693**	-2.015***	-1.862***	-1.631**	-0.168***	-0.158***	-0.142**
	(0.514)	(0.480)	(0.689)	(0.546)	(0.452)	(0.664)	(0.036)	(0.038)	(0.066)
CProductXPost	-0.746***	-0.799***	-0.848***	-0.731***	-0.742***	-0.792***	-0.063***	-0.077***	-0.082***
	(0.266)	(0.265)	(0.259)	(0.243)	(0.246)	(0.241)	(0.023)	(0.022)	(0.022)
IFirm-ProductXPost	0.942	-0.608	-0.791	0.837	-0.633	-0.825	0.071	-0.049	-0.069
	(1.107)	(0.762)	(0.791)	(1.049)	(0.727)	(0.770)	(0.083)	(0.056)	(0.060)
IFirmXPost	-0.513	-0.561	-0.245	-0.444	-0.464	-0.154	-0.057	-0.046	-0.029
	(0.801)	(0.570)	(0.531)	(0.747)	(0.516)	(0.482)	(0.070)	(0.046)	(0.044)
Observations	12893	9043	8384	12893	9043	8384	12893	9043	8384
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSize×Post	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table shows the main results excluding firms and destinations that contributed over 80% of the growth spike of dairy exports between 2006 and 2007. The unit of observation is at the firm-product-year level. The sample contains all dairy exporters in the Chinese Customs data (2000-2013). We create a balanced panel at the firm-product (HS eight-digit) and year level for the outcomes in all columns. Columns 1-6 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, namely, export value and export quantity, while Columns 7-9 use an indicator for positive exports as the outcome variable. Columns 1, 4, and 7 include all dairy exporters in the Chinese Customs data, excluding firms that contributed over 80% of the growth spike of dairy exports between 2006 and 2007. Columns 2, 5, and 8 drop the export destinations that contributed over 80% of the growth spike of dairy exports between 2006 and 2007. Columns 3, 6, and 9 drop both the identified firms and destinations. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the firm-product and year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table A.7: Robustness Check of Firm-Product-Level Analysis: Government Regulations

	IHS (Value)		IHS (Quantity)		Log (Price)		Exporting (dummy)	
	w/o Bans	All	w/o Bans	All	w/o Bans	All	w/o Bans	All
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CFirm-ProductXPost	-0.695	-0.489	-0.515	-0.345	-0.102	-0.122	-0.027	-0.019
	(1.606)	(1.180)	(1.547)	(1.157)	(0.096)	(0.091)	(0.107)	(0.078)
CFirmXPost	-1.519*	-1.838***	-1.535**	-1.811***	0.216***	0.209***	-0.134**	-0.153***
	(0.773)	(0.437)	(0.760)	(0.456)	(0.071)	(0.051)	(0.053)	(0.031)
CProductXPost	-0.904***	-0.773***	-0.878***	-0.757***	-0.204**	-0.157*	-0.070***	-0.064***
	(0.307)	(0.281)	(0.280)	(0.257)	(0.091)	(0.087)	(0.025)	(0.023)
IFirm-ProductXPost	1.540	1.083	1.420	0.981	-0.147	-0.211**	0.108	0.081
	(1.084)	(0.978)	(1.023)	(0.929)	(0.090)	(0.083)	(0.078)	(0.071)
IFirmXPost	-0.751	-0.944	-0.660	-0.847	0.203*	0.219**	-0.062	-0.081
	(0.857)	(0.768)	(0.793)	(0.708)	(0.104)	(0.097)	(0.071)	(0.063)
Observations	9877	13775	9877	13775	1113	1519	9877	13775
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES

Notes: This table compares regression results for exports to countries without explicit import bans on Chinese dairy products to our baseline estimates from Table 4, reported here in Columns 2, 4, 6, and 8 for ease of visualization. The unit of observation is at the firm-product-year level. The sample in Columns 1, 3, 5, and 7 contains dairy exporters in the Chinese Customs data (2000-2013), excluding firm-products exported to countries with bans. We create a balanced panel at the firm-product (HS eight-digit) and year level. Columns 1-4 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, export value (Columns 1 and 2) and export quantity (Columns 3 and 4). Columns 5 and 6 present results for the natural logarithm of unit price, while Columns 7 and 8 use an indicator for positive exports as the outcome variable. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export revenue. Standard errors are two-way clustered at the firm-product and year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table A.8: Heterogeneous Impact Based on the Google Search Index

	IHS (Value)				IHS (Quantity)				Exporting			
	>75 perc	50-75 perc	25-50 perc	<25 perc	>75 perc	50-75 perc	25-50 perc	<25 perc	>75 perc	50-75 perc	25-50 perc	<25 perc
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CFirm-ProductXPost	-1.101	0.376	-0.150	-0.811	-0.958	0.380	-0.136	-0.772	-0.061	0.032	-0.019	-0.047
	(1.391)	(0.447)	(0.329)	(0.995)	(1.349)	(0.464)	(0.298)	(0.957)	(0.094)	(0.035)	(0.027)	(0.067)
CFirmXPost	-0.571	-0.640	-0.544***	-0.869*	-0.650	-0.625	-0.500***	-0.822*	-0.055	-0.051	-0.047***	-0.068**
	(0.639)	(0.474)	(0.166)	(0.447)	(0.657)	(0.491)	(0.156)	(0.420)	(0.047)	(0.038)	(0.014)	(0.034)
CProductXPost	-0.025	-0.236**	-0.237**	-0.337**	-0.057	-0.195*	-0.226**	-0.313**	-0.001	-0.021**	-0.021**	-0.027**
	(0.152)	(0.115)	(0.110)	(0.136)	(0.138)	(0.105)	(0.107)	(0.127)	(0.013)	(0.010)	(0.009)	(0.012)
IFirm-ProductXPost	0.391	0.075	0.182	0.324	0.363	0.050	0.175	0.281	0.023	0.003	0.012	0.019
	(0.496)	(0.514)	(0.147)	(0.523)	(0.494)	(0.512)	(0.138)	(0.486)	(0.038)	(0.043)	(0.014)	(0.040)
IFirmXPost	-0.259	-0.338	-0.406***	0.094	-0.231	-0.301	-0.379***	0.085	-0.026	-0.030*	-0.034***	0.009
	(0.368)	(0.226)	(0.130)	(0.286)	(0.362)	(0.205)	(0.122)	(0.255)	(0.037)	(0.016)	(0.010)	(0.025)
Observations	13775	13775	13775	13775	13775	13775	13775	13775	13775	13775	13775	13775
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table shows the regression results for the heterogeneous effects of the scandal on exports across destinations with different information accuracy. The unit of observation is at the firm-product-year level. The sample contains all dairy exporters in the Chinese Customs data (2000-2013). We create a balanced panel at the firm-product (HS eight-digit) and year level. Columns 1-8 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variables of interest, export value and export quantity. Columns 9-12 use an indicator for positive exports as the outcome variable. We categorize countries by high and low information accuracy about the scandal, using the Google search intensity ratio. ">75 perc" destinations have a ratio of searches for the word "Sanlu" relative to searches for "2008 Chinese milk scandal" in the top quartile; "50-75 perc" destinations have a ratio in the third quartile; "25-50 perc" destinations have a ratio in the second quartile; and "<25 perc" destinations have a ratio in the bottom quartile. We exclude results for countries without a Google search index from this table. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline total export revenue. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table A.9: Heterogeneous Impact by Baseline Export Value Share

	IHS (Value)				Exporting (dummy)			
	Large	Small	Large	Small	Large	Small	Large	Small
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CFirm-ProductXPost	-1.653	0.633	-1.666	0.590	-0.084	0.050	-0.084	0.048
	(2.658)	(1.551)	(2.593)	(1.564)	(0.164)	(0.117)	(0.160)	(0.119)
CFirmXPost	-0.950	-2.712***	-0.877	-2.678***	-0.086	-0.238***	-0.081	-0.236***
	(1.275)	(0.851)	(1.252)	(0.875)	(0.081)	(0.082)	(0.079)	(0.083)
CProductXPost	-0.097	-1.786**	0.301	-1.707*	-0.021	-0.151**	0.004	-0.147*
	(1.324)	(0.836)	(1.546)	(0.933)	(0.100)	(0.074)	(0.115)	(0.082)
IFirm-ProductXPost	-3.465***	-0.412	-3.464***	-0.428	-0.221***	-0.008	-0.220***	-0.009
	(0.197)	(0.935)	(0.183)	(0.957)	(0.014)	(0.088)	(0.013)	(0.090)
IFirmXPost	-2.808***	0.032	-2.773***	0.083	-0.189***	-0.044	-0.188***	-0.042
	(0.805)	(0.985)	(0.771)	(1.011)	(0.061)	(0.095)	(0.058)	(0.098)
Observations	1568	1540	1568	1540	1568	1540	1568	1540
Firm-product FE	YES	YES	YES	YES	YES	YES	YES	YES
BaselineSizeXPost	YES	YES	YES	YES	YES	YES	YES	YES
HS2digitXYear	YES	YES	NO	NO	YES	YES	NO	NO
H2digitXPost	NO	NO	YES	YES	NO	NO	YES	YES

Notes: This table shows the regression results for the heterogeneous effects of the scandal on exports across firms with different baseline export value shares. The unit of observation is at the firm-product-year level. The sample contains dairy exporters in the Chinese Customs data (2007) that can be matched with the Manufacturing Survey data (2007). We create a balanced panel at the firm-product (HS eight-digit) and year level. Columns 1-4 present results for the inverse hyperbolic sine (IHS) transformation of the outcome variable of interest, export value. Columns 5-8 use an indicator for positive exports as the outcome variable. Columns 1, 3, 5, and 7 use the subsample of firms with a large baseline export value share, defined as above the median of 9.77%. Columns 2, 4, 6, and 8 use the subsample of firms with a small baseline export value share, defined as below the median. The interaction terms are the products of the post-scandal dummy (2009-2013) with the following five group indicators: (C)ontaminatedFirm-Product, (C)ontaminatedFirm, (C)ontaminatedProduct, (I)nnocentFirm-Product, and (I)nnocentFirm. The omitted category is innocent and uninspected products from uninspected firms. All regressions include firm-product and year fixed effects. Baseline size measures a firm's baseline (2000-2007) total export value. Standard errors are two-way clustered at the firm and product-year level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Appendix B: Data Appendix and Codebooks

Table B.1: Destinations that Imposed Import Bans on Chinese Dairy Products

Country	Value Share of dairy	Value share of milk powder	Year lifted
(1)	(2)	(3)	(4)
Taiwan	.114762	.275012	
EU	.092145	.000025	2015
US	.045939	.000060	
Singapore	.027706	.014324	2009
Philippines	.026908	.021784	
Bangladesh	.015800	.040019	
South Korea	.014377	.001128	
Indonesia	.006741	.000651	
Vietnam	.006241	.014093	
Malaysia	.006061	.001471	
India	.002123	.001910	2017
Ghana	.001603	.002978	
Ivory Coast	.001298	.003214	
Gabon	.000357	.000923	
Tanzania	.000217	.000561	2010
Colombia	.000135	.000042	
Kenya	.000058	.000109	
Chile	.000043	0	
Brunei	.000028	0	
Ivory Coast	0	0	
Kyrgyzstan	0	0	

Notes: This table shows the list of destinations that imposed bans on Chinese dairy/food products due to the scandal. For each destination, we report the value share of dairy products exported to the destination prior to the scandal (2000-2007), the value share of milk powder products exported to the destination prior to the scandal (2000-2007), and the year that the bans were lifted.

Table B.2: HS Eight-Digit Codebook for Dairy Products

HS Eight-Digit Code	Product Category	Product Description	Baseline Export Value Share
04011000	fresh milk products	Milk and cream, not concentrated nor containing added sugar or other sweetening matter, of a fat content, by weight, not exceeding 1%	0.00%
04012000	fresh milk products	Milk and cream, not concentrated nor containing added sugar or other sweetening matter, of a fat content, by weight, exceeding 1% but not exceeding 6%	18.44%
04013000	fresh milk products	Milk and cream, not concentrated nor containing added sugar or other sweetening matter, of a fat content, by weight, exceeding 6%	0.26%
04014000	fresh milk products	Milk and cream, not concentrated nor containing added sugar or other sweetening matter, of a fat content, by weight, exceeding 6% but not exceeding 10%	0.00%
04015000	fresh milk products	Milk and cream, not concentrated nor containing added sugar or other sweetening matter, of a fat content, by weight, exceeding 10%	0.00%
04021000	milk powder	Milk and cream in solid forms of $\leq$ 1.5% fat	3.36%
04022100	milk powder	Milk and cream in solid forms of $>$ 1.5% fat, unsweetened	28.49%
04022900	milk powder	Milk and cream in solid forms of $>$ 1.5% fat, sweetened	6.88%
04029100	condensed milk products	Concentrated milk and cream, unsweetened (excl. in solid form)	3.54%
04029900	condensed milk products	Sweetened milk and cream (excl. in solid form)	5.99%
04031000	cultured milk products	Yogurt	0.1%
04039000	cultured milk products	Buttermilk, curdled milk and cream, etc (excl. yogurt)	0.41%
04041000	whey products	Whey and modified whey	0.01%
04049000	whey products	Other products consisting of natural milk constituents	0.75%
04051000	milk fat products	Butter	1.09%
04052000	milk fat products	Dairy spreads	0.00%
04059000	milk fat products	Other fats and oils derived from milk	0.46%
04061000	cheese products	Fresh cheese, incl. whey cheese and curd	1.27%
04062000	cheese products	Grated or powdered cheese, of all kinds	0.00%
04063000	cheese products	Processed cheese, not grated or powdered	0.01%
04064000	cheese products	Blue-veined cheese and other cheese containing veins produced by penicillium requefort	0.00%
04069000	cheese products	Other cheese	0.02%
19011000	infant formula	Preparations for infant use, for retail sale	0.64%
19019000	malted milk products	Other food preparations of malt extract, flour; dairy products(Cocoa content:¡40% of powder, starch or malt extract, or Cocoa contents:¡5% of dairy products)	11.57%
35011000	milk protein produts	Casein	16.67%
35022000	milk protein produts	Milk albumin, incl. concentrates of two or more whey proteins	0.04%

Notes: The HS code for infant formula is 1901100010. Since the HS ten-digit information is not available in the Customs data, we use the eight-digit code 19011000 to indicate infant formula. The baseline export value share is the export value share across all dairy products from 2000 to 2007.

Appendix C: Industry-Level Analysis: Alternative Strategies

This section investigates whether the results obtained in the DD framework are robust to relaxing the parallel trends assumption at the industry level. Specifically, C.1 and C.2 allow for unobserved interactions between time-varying factors and industry fixed effects (FE) using interactive fixed effects (IFE). Gobillon and Magnac (2016) discuss how the IFE method generalizes the synthetic control design when the matching variables (i.e., factor loadings and exogenous covariates) of the treated unit do not belong to the convexified support of the matching variables of the control units, which they call the extrapolation case. Given the unique growth path of the Chinese dairy industry prior to the scandal, we might very well find ourselves in the extrapolation case. Nonetheless, the synthetic control analysis reassuringly confirms both our baseline and IFE estimates. Given this battery of robustness checks, we are confident that our DD estimates capture the true effect of the scandal on the export performance of the Chinese dairy industry, and we report these DD estimates as our preferred ones.

C.1 Interactive Fixed Effects

Following Gobillon and Magnac (2016), we use least squares minimization to estimate Equation (3), where δ_t is an $L \times 1$ vector of time factors and γ_j is an $L \times 1$ vector of factor loadings (Bai, 2009). The IFE model assumes that the interaction term $\delta_t^{'} * \gamma_j$ fully describes the unobserved heterogeneity and that the dimension of the time factors and factor loadings, L, is known. Our estimates are robust to different values of L.

$$Y_{jt} = \beta_{\text{dairy}} \text{Dairy}_j \times \text{Post}_t + \delta_t^{'} * \gamma_j + \pi X_{jt} + \epsilon_{jt} \tag{3}$$

Our estimates of Equation (3) show that the DD estimates are virtually identical to the equivalent IFE models of dimension one. For example, the baseline specification without

controls in Column 1 of Table C.1, Panel A, estimates that the scandal decreased the value of Chinese dairy exports by 65.6%. Adding controls for the value share of the industry exported to different continents at baseline interacted with year indicators in Column 5 yields an estimated decrease in the export value of 68.2%, very similar to our preferred estimate in Column 4 of Table 3 with controls for the industry-specific linear trend in the DD setting. Similarly, Column 4 of Table C.1 can be compared to Column 2 of Table 3 to confirm that the scandal did not significantly affect non-dairy food exports.

Finally, Columns 2 and 3 of Table C.1 allow for increasingly multi-dimensional interactions between time factors and industry factor loadings. These models estimate an impact of the scandal on dairy exports that is larger in magnitude than the one that we estimate in the classic DD model. Because the dimension of these IFE models is set somewhat arbitrarily or assumed to be known (Gobillon and Magnac, 2016), our preferred estimate remains the more conservative one in Column 4 of Table 3, that is, a 68% decrease in the value of dairy exports following the scandal.

Panel B of Table C.1 confirms the patterns shown in Panel B of Table 3: the spillover effect of the scandal leads to a decrease in exports of innocent and uninspected firm-products that is smaller than the total effect of the scandal on the dairy sector. Specifically, using IFE, we estimate spillover effects on exports characterized by a decrease of between 50 and 73%.

C.2 Synthetic Control

In the case of a single treated unit, synthetic control methods can successfully construct a vector of weights such that a weighted combination of control units closely matches the time series of the outcome variable for the treated unit in the pre-period (Abadie and Gardeazabal, 2003; Abadie, Diamond, and Hainmueller, 2010). We estimate the impact of the scandal as the difference between the value of exports in the dairy industry and the synthetic unit

before and after the scandal, as given by Equation (4).

$$\hat{\beta} = \sum_{t=2009}^{2013} \left(Y_{1t} - \sum_{i=2}^{N} w_i^*(V^*) Y_{it} \right) - \sum_{t=2000}^{2008} \left(Y_{1t} - \sum_{i=2}^{N} w_i^*(V^*) Y_{it} \right) \tag{4}$$

We denote the dairy industry with index 1; w_i^* are the optimal weights on control units; and V^* minimizes the distance between the predicted pre-treatment outcomes of the treated and synthetic control units, with predictions based on an arbitrary set of baseline covariates. Specifically, we use an indicator for whether an industry was exporting in a given year and the value share of the industry exported to different continents as the baseline covariates to predict outcomes.

The solid line in Figure C.1 plots the natural logarithm of the value of exports for the Chinese dairy industry over our sample period. As discussed in Section 2, we observe that Chinese dairy exports grew substantially prior to the scandal. The dashed line plots the natural logarithm of the value of exports for the synthetic control unit, created using industry and covariate weights specified in Table C.2.[26] Reassuringly, the synthetic control unit mimics the growth of the dairy sector quite closely prior to 2009, the first year after the scandal. Starting in 2009, while the synthetic control unit continues to grow through 2011, the dairy industry experiences a drop in exports that persists through 2010, stabilizing around the value levels observed in 2004-2006. Averaging the difference between the logarithm of the value of exports of the dairy industry and the synthetic control unit before and after the scandal, as described in Equation (4), we obtain an estimated impact of the scandal of -71%, in line with our DD estimate.

Abadie, Diamond, and Hainmueller (2010) prove that the bias of the synthetic control estimator can be bounded by a function that goes to zero as the number of pre-treatment periods increases. Intuitively, a longer baseline allows for a more precise calibration of the

[26]This table shows that the weights selected by the data-driven algorithm in the synthetic control methodology appear to be somewhat disconnected from those predicted by economic theory, leaving doubts as to the interpretation of the results. Moreover, the weights are positive for only a handful of industries (Panel A) and heavily skewed on a handful of covariates.

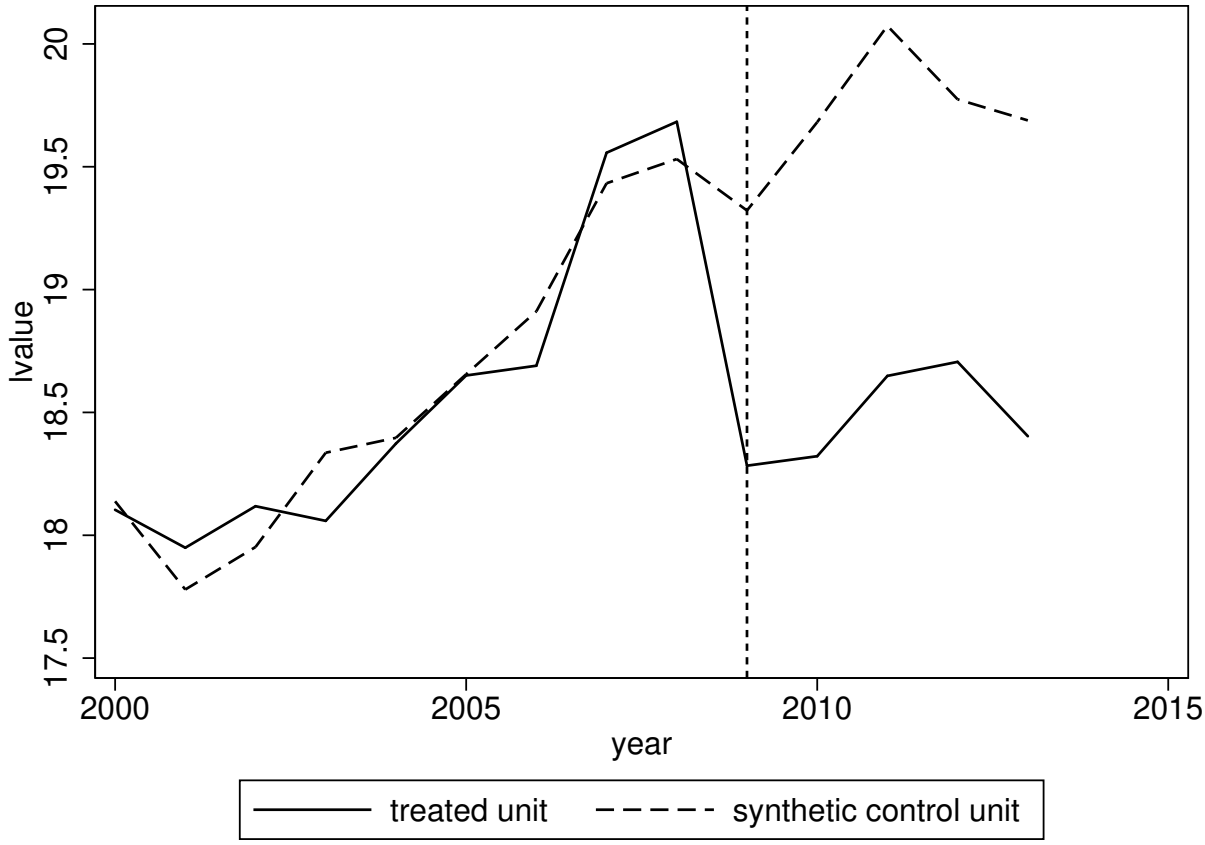
weights, which improves the match between the treated and control outcomes. As our sample only provides eight years of pre-scandal data, we might worry that the estimated impact of the scandal is confounded by residual unobserved differences between the dairy industry and the synthetic control unit. To assuage this concern, we perform inference by permuting the treatment to each unit in our donor pool of control industries, following Abadie, Diamond, and Hainmueller (2010). Figure C.2 plots the difference in the logarithm of the value of exports between each industry and that of its synthetic control unit over time. We can contrast all the placebo differences (in grey) with the difference for the dairy industry (in black) and observe that the dairy industry synthetic control provides a good match in the pre-scandal period; i.e., the pre-scandal difference lies comfortably within the placebo band. Moreover, there are only five other industries that display a larger treatment effect in the post-scandal period. Given that we have 76 placebo differences, the p-value on our estimate, i.e., the likelihood of erroneously rejecting the hypothesis of a null effect of the scandal on the dairy industry, is 6/76, or 0.08.[27]

Analogously to the analysis in Panel B of Table 3, Figure C.3 shows the spillover effect of the scandal on the sample of innocent and uninspected dairy firm-products. Unlike the DD and IFE estimates, however, the synthetic control methodology estimates an indirect effect of -74%, with a point estimate that is larger than the total effect of -71%.[28] Nonetheless, Figure C.4 shows that there are four industries with a larger placebo difference than the dairy industry, implying a p-value on our estimate of 5/76, or 0.06. Therefore we cannot reject the hypothesis that the indirect effect of the scandal on innocent and uninspected firm-products is as large as the total effect on the entire dairy industry.

[27]The algorithm for the construction of the synthetic control unit for industries with HS codes 28, 32, and 99 fails to converge.

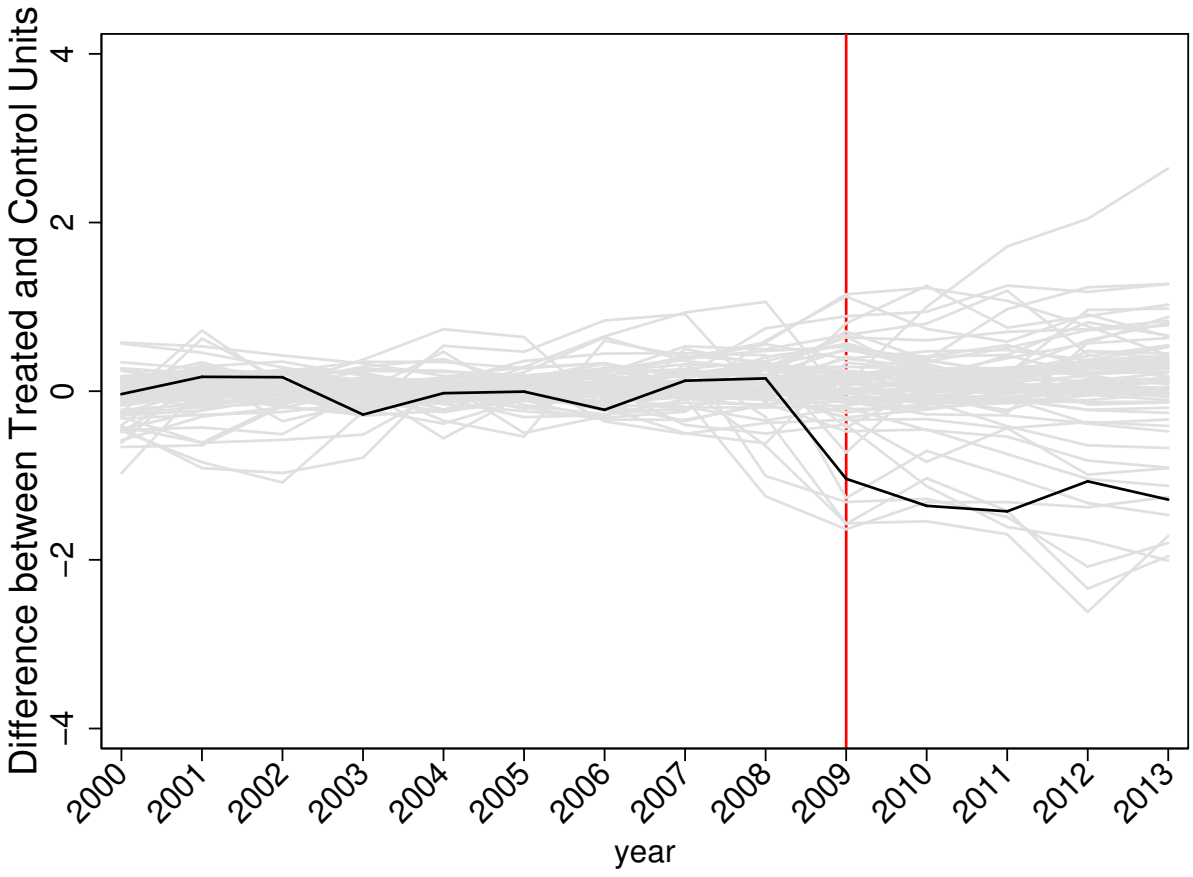
[28]Industry and covariate weights used to select the synthetic control unit plotted in Figure C.3 are shown in Tables C.2

Figure C.1: Synthetic Control Analysis: All Dairy Exports



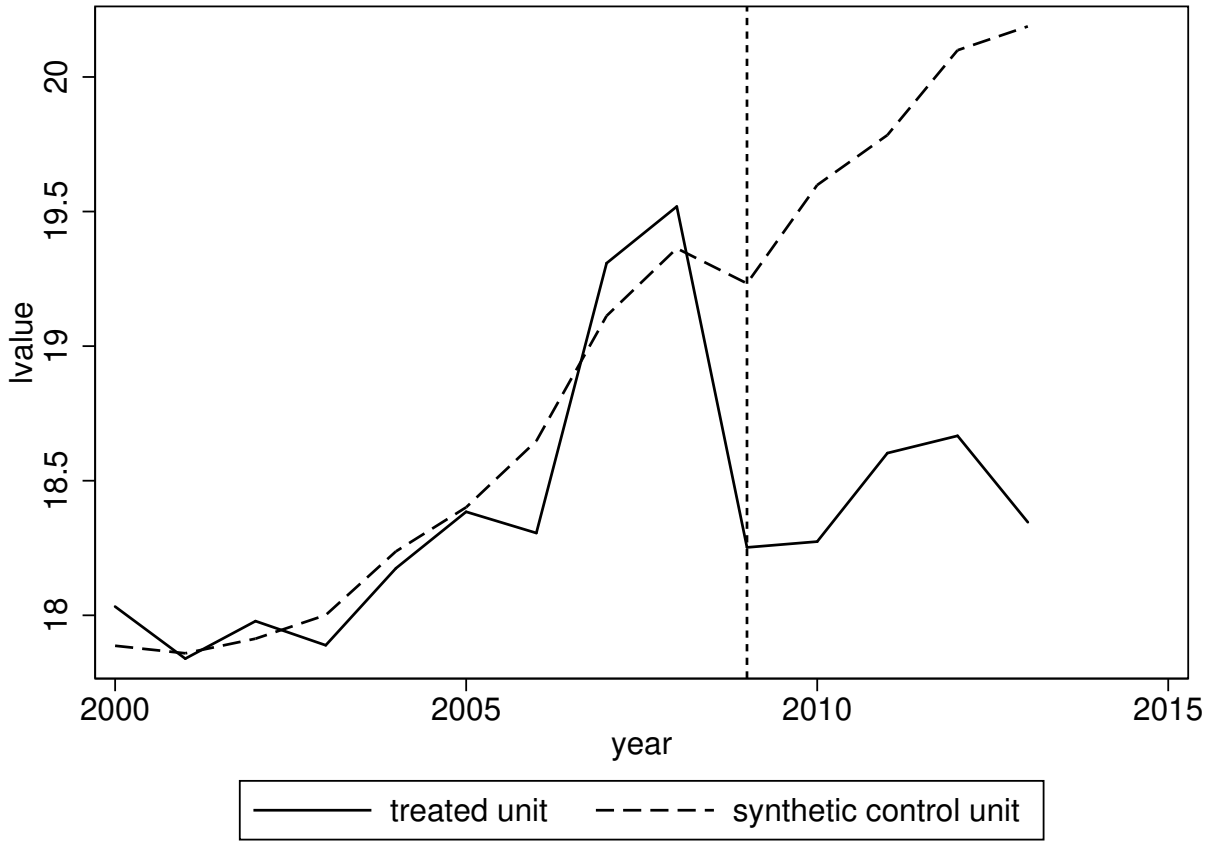
Notes: This figure plots the natural logarithm of the value of exports for the dairy industry (solid line) and the synthetic control unit (dashed line). The vertical dotted line indicates 2009, the first year after the scandal.

Figure C.2: Synthetic Control Analysis: All Dairy Exports, Placebo



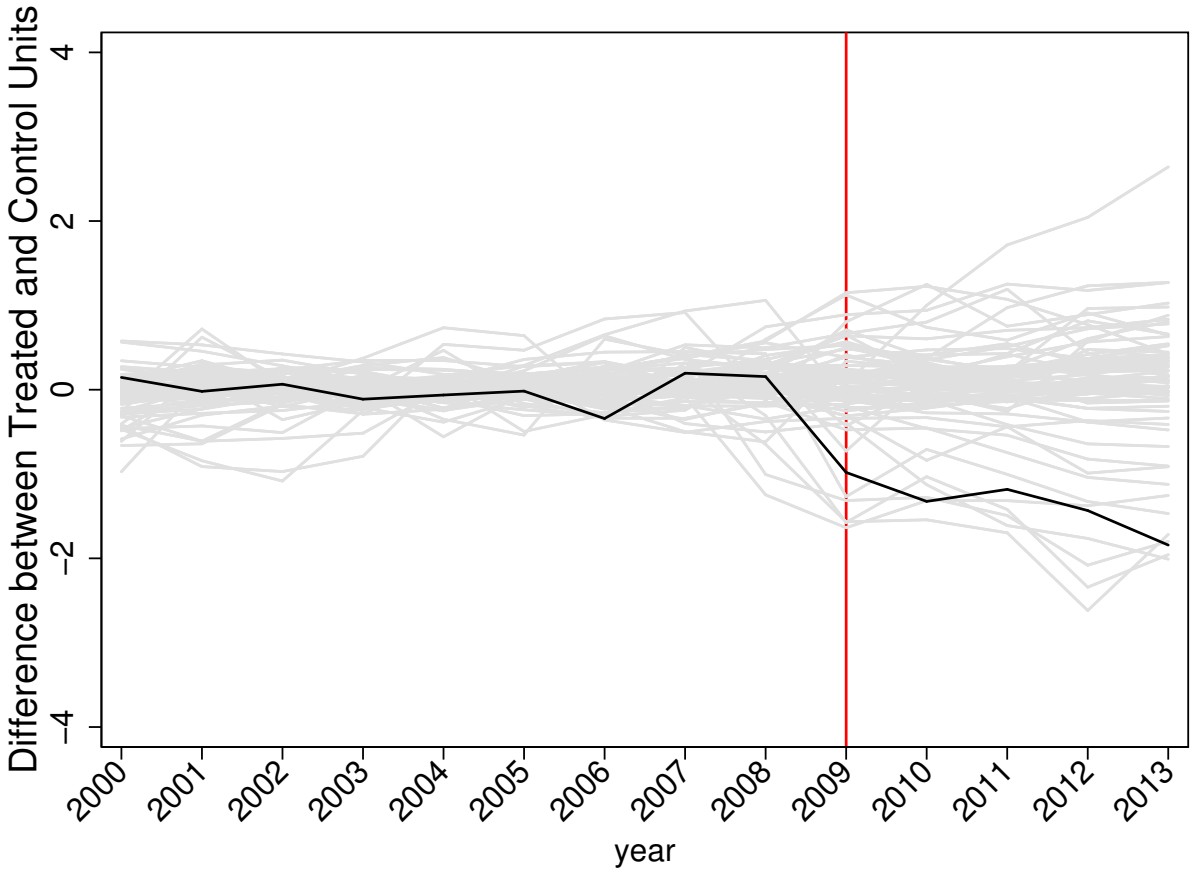
Notes: This figure plots the difference in the log value of exports between each industry and its respective synthetic control unit. The black line indicates the dairy industry. The vertical red line indicates 2009, the first year after the scandal.

Figure C.3: Synthetic Control Analysis: Dairy Exports of Innocent and Uninspected Firm-Products



Notes: This figure plots the natural logarithm of the value of exports for the dairy industry excluding the contaminated firm-products (solid line) and the synthetic control unit (dashed line). The vertical dotted line indicates 2009, the first year after the scandal.

Figure C.4: Synthetic Control Analysis: Dairy Exports of Innocent and Uninspected Firm-Products, Placebo



Notes: This figure plots the difference in the log value of exports between each industry and its respective synthetic control unit. The black line indicates the dairy industry excluding the contaminated firm-products. The vertical red line indicates 2009, the first year after the scandal.

Table C.1: Interactive Fixed Effects Analysis at the HS Two-digit Industry Level

Dep Var: Log (Export Value)	(1)	(2)	(3)	(4)	(5)
	Panel A. All Dairy Exports				
DairyXPost	-1.067***	-1.505***	-1.356***	-0.947***	-1.146***
	(0.067)	(0.064)	(0.078)	(0.090)	(0.297)
FoodXPost				-0.122	
				(0.119)	
Observations	1120	1120	1120	1386	1106
	Panel B. Innocent+Uninspected Firm-Products Only				
DairyXPost	-0.872***	-1.296***	-1.304***	-0.748***	-0.699**
	(0.076)	(0.062)	(0.062)	(0.089)	(0.319)
FoodXPost				-0.122	
				(0.119)	
Observations	1120	1120	1120	1386	1106
Dimension of Factor Model	1	2	3	1	1
YearXValue Share to different continents	NO	NO	NO	NO	YES
Whether Dropped Food	YES	YES	YES	NO	YES

Notes: This table shows the regression results for the industry-level analysis using interactive fixed effect models. Panel A includes all exporters, collapsed to the industry-year level. Panel B excludes contaminated firm-products to quantify the aggregate spillover effect. We create a balanced panel at the industry (HS two-digit) and year level. The dependent variable is log annual export value for each industry. Columns 1-3 use different dimensions for the factor model. All columns include year and industry fixed effects. Column 5 adds a time-varying control, which is the value share exported to different continents at baseline (2000-2007) interacted with year indicators. Columns 1, 2, 3, and 5 exclude non-dairy food industries; Column 4 includes all HS two-digit industries. Standard errors are clustered at the product (HS two-digit) level. *** denotes significance at the 0.01, ** at the 0.5, and * at the 0.1 level.

Table C.2: Weights for Synthetic Control Analysis

	All Dairy Exports (1)	Dairy Exports of Innocent and Uninspected Firm-Products (2)
	Panel A. Industry Weights	
01	0.274	0.001
14	-	0.002
23	-	0.126
31	0.301	0.115
45	-	0.001
47	0.406	0.023
60	-	0.213
93	-	0.487
99	0.019	0.030
	Panel B. Covariates Weights	
Log Value	974.6622	861.9878
Positive Exports	3.3724	0.0000030
Value Share to Asia	2.7599	0.00000003
Value Share to Europe	0.3773	135.5426
Value Share to Africa	0.1043	2.4695
Value Share to Oceania	0.0006853	0.0000010
Value Share to North America	18.5361	0.00000006
Value Share to Latin America	0.1872	0.0000020

Notes: The table shows the weights for industries for the synthetic control analysis for all dairy exports (Column 1) and dairy exports of non-contaminated firm-products (Column 2). Panel A shows the non-zero weights assigned to industries at the HS two-digit level for the synthetic control analysis. Panel B shows the weights($\times 1,000$) for covariates for the synthetic control analysis. HS 01 represents the live animals industry. HS 14 represents the vegetable plaiting materials industry. HS 23 represents food industries producing residues and wastes thereof or prepared animal fodder. HS 31 represents the fertilizers industry. HS 45 represents the cork and cork articles industry. HS 47 represents the fibrous cellulosic material and recovered paper or paperboard industry. HS 60 represents the fabrics industry. HS 93 represents the arms and ammunition industry. HS 98 comprises special classification provisions. HS 99 contains temporary modifications pursuant to a party's national directive or legislation.